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Francis William Stubbs.

23174 e. 36

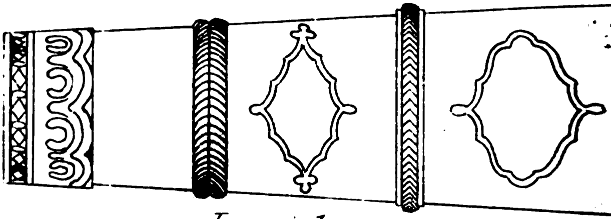
MADRAS
ARTILLERY RECORDS
VOLUME. I.

Iron Gun in Asseerghur, drawn from

Artillery

Mool- ki

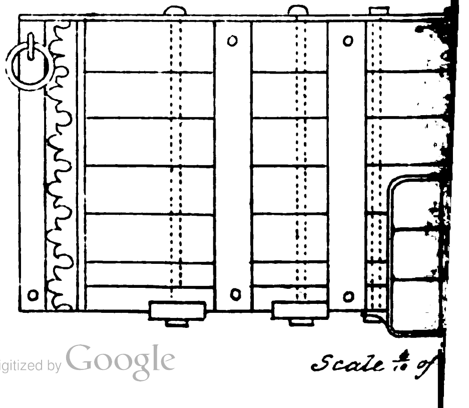
fig 4



Inscriptions

زبس که اخگر غم پر بود درون منم
چون کوره میزند آتش زبانه از دهنم
ابو المظفر محی الدین محمد اورنگ زیب
بهادر عالمگیر بادشاه غازی
سنه ۱۰۷۱
در بلده برهان پور
نواب ملک هیبت
عمل محمد حسین عرب
ولسي و پنج آثار دار و دوازده آثار
بوزن شاه جهان

Traversing

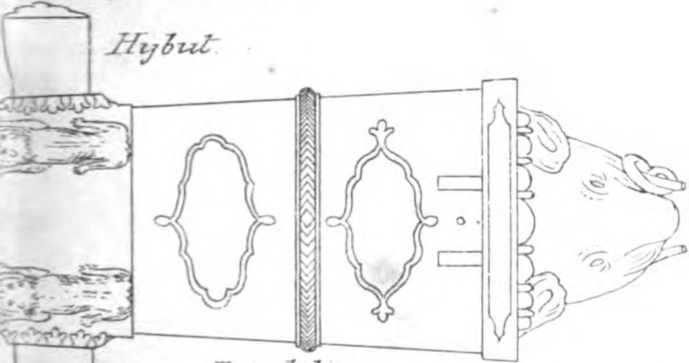


Artillery Depôt
1839

Scale ⅛ of

odels made by Capt^{n} Lucas of the Bombay

by Capt^{n} Jacob.



Tranlation

The heart is filled with the sparks of grief. The fire blazes forth as if in a furnace.

round the muzzle

Abool Muzuffur Moheizoodeen Mahomed Aurungzeeb Buhadoor aulum geer Badeshah Gazee.

1074

In Scrolls

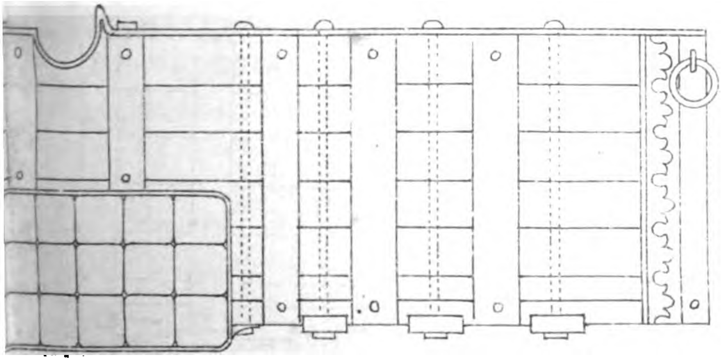
In the city of Boorhanpoor.

Gun of the King.

Umul Mahomed Hossein Urub.

A cannon ball weighing thirty five seers and gunpowder weighing 12 seers of Shah Juhan

arriage for the above.



inch to a foot.

PREFACE.

Whatever merits or demerits there may be in the following pages, the welfare of the Regiment, to which the compiler has the honour to belong, has been the sole motive which induced him to propose to his Brother Officers, the condensing and printing the "Madras Artillery Records."

In collecting materials for the work, it struck him that the introduction of Artillery papers, Artillery and General Orders, Memoranda on interior Regimental economy, would be valuable to Officers who may hereafter join the Regiment.

The work will be so published as to allow of the different subjects being bound up separately at the end of each year, when a general Index will be published.

The compiler lays no claim to authorship, for he has only extracted from a variety of works, such matter as he deemed useful, and he would gladly have quoted his authorities, but did not wish to crowd the "Records."

ARTILLERY.

ANCIENT ARTILLERY.

In the most ancient times, when the use of Artillery was unknown, the club and the dart were at this time the only instruments of attack and defence; and it was probably some time before the bow and arrow were thought of as offensive weapons.

As the destructive means of attack were by the latter invention made to operate at a distance, corresponding means of defence became necessary, and trunks of trees interlaced with branches and supported with earth, constituted the first fortification; which was afterwards improved by substituting a wall with a parapet, for shooting arrows at the assailants. Afterwards the walls were carried higher, and holes left in them of sufficient size only to enable the archers to discharge their arrows effectually upon an enemy.

To attack, therefore, with any chance of success, some powerful engine became necessary to batter down the walls; this gave rise to the battering ram, which was probably one of the first engines of ancient Artillery. To what date to refer the invention of this powerful machine is uncertain. In the second book of Chronicles, Uzziah, who began his reign 809 years before the Christian era "made in Jeru-" salem, engines invented by cunning men, to be upon the " towers and upon the bulwarks to shoot arrows and great " stones withal." It is therefore probable that the ram was at least known in those days, although there is no distinct mention of it until the time of Pericles, the Athenian, 409 years before Christ. To oppose this powerful engine of attack, farther means of defence became necessary, and the invention of ballistæ and catapultæ, resulted probably from this necessity. But these soon became instruments not only of defence, but of attack; for in the siege of Moyta, about 370 years before Christ, Dionysius, after having battered down the fortification with his rams, advanced to the walls towers rolled upon wheels, whence he galled the besieged with continual vollies of stones, and darts thrown from his catapultæ.

A number of other instances are mentioned soon after this time, in which machines of various descriptions both for defence and attack, of which are made mention of in particular the siege of Saguntum, by Hannibal, 219 years before Christ, in which the Saguntines prevented his soldiers from using the battering ram by a continual hurling of darts, stones, and other missiles. From this time these warlike engines encreased, both in number and magnitude, to an almost incredible extent; of which the reader may form some idea by the inventory that different historians have given us of those found in certain cities, which had been obliged to capitulate to the enemy; and by the enumeration of those which accompanied particular armies. Thus, Titus employed in the siege of Jerusalem 300 catapultæ of divers magnitudes, and 40 ballistæ, of which the least projected stones of 75lbs. weight. And when the consul Censorius marched against Carthage, and obliged the inhabitants to give up their arms, they surrendered to him 2,000 machines, proper for throwing darts and stones; and afterwards when Scipio made himself master of the same city, there were no less than 120 catapultæ of the larger size, 281 of the smaller; 23 of the larger ballistæ, 52 of a smaller kind, and innumerable number of scorpions of different sizes, arms, and missile weapons. Two years previous to this, Marcellus had laid siege to Syracuse, a city proverbially fatal to the armies that attacked it. Archimedes was at that time resident in the city, and, at the earnest solicitation of Hiero, King of Sicily, exerted the powers of his mind in the invention of artillery and other warlike instruments. Marcellus had brought with him an enormous engine mounted on eight gallies, called sambuca, which Archimedes destroyed by discharging at it single stones of enormous weight, while it was at a considerable distance from the walls, this was effected by ballistæ; but he also employed crows, grapples, and scorpions, by the former of which the Roman vessels were lifted out of the water by the prow and plunged to the bottom of the sea.

The ancient artillery may be divided into three classes of machines, viz.; first, those intended for projecting bodies; secondly, those for approach and demolition; thirdly, a miscellaneous class, used for various offensive operations.

OF THE BALLISTÆ.

The force of the ballista was prodigious, the stones cast from them were of enormous weight and of any form, and for the further annoyance of the besieged place they would throw into it from the ballistæ, dead bodies of men and and horses, heads and detached limbs. Athenæus mentions one of these ballistæ that threw a stone of three talents, viz. about 360lbs. weight. Cæsar employed these machines not only to destroy men, but to batter down strong and high towers. The machines employed by Titus against Jerusalem, some of which Josephus states, projected stones of a hundred weight, and Archimedes is said to have cast bodies of 1,200lbs. by means of his ballistæ, against the Roman fleet in his defence of Syracuse. Fig. 1.

OF THE CATAPULTÆ.

These were employed in throwing either darts or arrows; which it is said were sometimes poisoned, and at others set on fire.

A catapulta of the smaller kind, Fig. 2, consists merely of an immense bow of elastic wicker work placed on a suitable carriage and having its upper part drawn down by the force of several men applied to a strong rope. Several arrows are lodged on a suitable frame and at different elevations. The tightened cord being set at liberty by drawing out a pin, the bent surface recovering itself by its natural elasticity, advances to its original vertical position and thus drives before it all the arrows with considerable velocity. This kind of catapultæ is mentioned by Diodorous Siculus as being employed at the siege of Cyprus.

Catapultæ of the larger kind, Fig. 3, were much more powerful and were used to shoot darts and arrows of great length and weight.

The impulsive energy of these machines far exceeds the ideas entertained of them. It is said that Montflaucon possessed a small model of a catapulta, only five inches in length, which projected its dart to the distance of 400 feet; and Folard, the learned editor of Polybius, had a model only a foot in each dimension, which propelled its dart with such force as to cause it to enter and remain in hard freestone at the distance of 1,300 feet. Cæsar also relates that at the siege of Marseilles, the besieged propelled from the top of their walls, beams of 12 feet long armed at one end by pointed iron heads, which pierced four ranks of stout hurdles, and then stuck firmly into the ground.

SCORPION.

The scorpion, Fig. 4, is another of the propelling machines of the ancients, and is probably of anterior date to those we have been describing, being far inferior to them in action, although still a very powerful engine.

ARCOBALLISTA.

The arcoballista, Fig. 5, is a smaller propelling apparatus, which might be worked by one man, it is little more than a fixed bow with a simple mechanical contrivance for bringing back the line.

The above are the principal machines which the ancients possessed for distant means of annoyance, it still remains to describe those employed on a near approach to an enemy's works for the demolition of the same, and the opposing engines of the besieged.

MACHINES OF APPROACH AND DEMOLITION.

OF THE BATTERING RAM.

The ancients employed two different machines of this kind; the one suspended, and which was vibrated after the manner of a pendulum, and the other moveable on rollers. These were denominated the swinging and rolling ram, and when either of these was worked under a cover or shed to protect the assailants from the annoyance of the besieged, they were denominated tortoise rams, from the shell being assimulated to the tortoise shell.

The swinging ram, Fig. 6, resembled, as well in its magnitude as in its form, the mast of a large vessel, suspended horizontally at its centre of gravity, by chains or cords from a moveable frame of carpentry. Ligatures of waxed cord surrounded the beam at short intervals, and cords at the extremity farthest from the head, served for the purpose of applying human force to supply the oscillatory motion. Other cords at intermediate distances were also sometimes employed. The frame of carpentry was often encased at its sides by a double cover of wicker work, between which horse hair and marine herbs were stuffed. The top was covered with sloping hurdles plastered with mortar, and in case of necessity, the whole was kept moist by vinegar, to prevent its being set on fire by the enemy. In this form it becomes what is denominated the tortoise ram.

The rolling ram, Fig. 7, was much the same as the above in its general construction, except that, instead of receiving a pendulous motion, it was a motion of simple alternation, produced by the strength of men applied to cords passing over pulleys. This construction seems to have been first employed at the siege of Byzantium.

These machines were often extremely ponderous. Appian declares that at the siege of Carthage, he saw two rams so colossal that one hundred men were employed in working each. And Vitruvius affirms that the beam was often from 100 to 120 feet in length, and Justus Lipsius describes some as 180 feet long and 2 feet 4 inches in diamater, with an iron head weighing at least a ton and a half.

Such a ram as described by Lipsius, would weigh more than 45,000lbs. and the momentum of this, supposing its velocity to be about two yards per second, would be nearly quadruple the momentum of a 40lb. ball moving with a velocity of 1,600 feet per second. But what would be the different operation of these bodies on a wall. The ball would penetrate the opposing substance, and pursue the almost undisturbed tenor of its way, but this is not the case with the ram. Its efficiency in the work of demolition would depend upon the due apportioning its intervals of oscillation. At first it would produce no obvious effect upon the wall; but the judicious repetition of its blows, would in a short time give motion to the wall itself. First, there would be just perceptible tremors, then more extensive vibrations, these being evident, the men would adjust the oscillations of the ram to that of the wall, till at length, a large portion of it, partaking of the vibratory impulse, would by a well timed blow fall to the earth at once. This recorded effect of the ram has nothing analogous in the results of modern machinery.*

The moveable towers Figs. 8, 9, employed by the ancients in their sieges, and which they called "helepoles" were often of astonishing magnitude. Vegetius describes them as being formed of strong planks. To preserve them from risk of fire thrown from the walls of the besieged place, they were covered with raw hides, or with pieces of woven horse hair. Their height was proportional to the dimensions of their bases, which were sometimes 30 feet square, and their height 40 or 50 feet. Sometimes their height was still greater, that they might be above the walls and even above the stone towers of the city. They were supported upon several small wheels, by means of which they might be moved from place to place, notwithstanding their enormous size and weight. It was generally reckoned that the besieged place was in imminent danger, whenever the besiegers had succeeded in placing one of these near the walls. The helepole was supplied with ladders, by which to mount from stage to stage, and each stage presented its particular means of attack. In the lower one there was commonly a ram, and the middle of the stage, or a higher one was furnished with a bridge made of mutually intersecting levers, which could be easily projected out, and thereby form a communication between the tower and the wall. Sometimes baskets fixed to projecting levers, carried men who were let down upon the wall. On the upper stages were soldiers armed with halberts, and archers who continually played upon the besieged.

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* It is not generally known that Captain DeButts of the Bengal Engineers not having any ordnance at the attack of a Ghurry in the upper part of Hindoostan constructed a battering ram and used it with success.

Vitruvius states that the weight of the helepoles brought against Rhodes by Demetrius weighed 260,000lbs. and that to mann and manœuvre it, employed 3,400 soldiers.

The tortoise, Figs. 10, 11, as already stated, was a kind of moving shed, used to defend the assailants in their advance upon the place ; these were also of great magnitude. One of those employed by Cæsar, at the siege of Marseilles was 60 feet long, and served to cover the space between the helepoles and the city wall. In some instances a long rank of these was placed end to end, and served as a complete protection to the soldiers, they were covered as already stated, with raw hides or with moistened horse-hair to protect them from the fire of the besieged.

MISCELLANEOUS MACHINES.

OF CROWS (CORVI) AND CRANES.

As in the application of the engines last described it was necessary for the besiegers to approach close under the walls of the besieged city, it was natural that the latter should attempt a means of annoyance or defence against their enemy which might counteract their efforts. This probably gave rise to the machines about to be described which were of different kinds, some being used in sieges, and others in engagements at sea. The description of these engines, and of the effects produced by them is scarcely credible. When Marcellus had advanced his galleys close under the walls of Syracuse, Archimedes directed against them enormous machines which being projected forward, there were let down suddenly from them large beams, from which were suspended long vertical arms of rope, terminated with grappling hooks, which laying hold of the vessels, and rapidly elevating them by the operation of counterweights, upset and sunk them to the bottom of the sea, or after raising them by their prows and setting them as it were on their poops, plunged them endwise into the water. Others it is said he swung round towards the shore by the application of his cranes, and after whirling them in the air, dashed them to pieces on the rocks beneath. Although it is impossible not to suspect some degree of exaggeration in these statements, yet it cannot be doubted that very powerful means of this kind were employed in this celebrated siege ; in which Archimedes the prince of Grecian mathematicians, fell beneath the sword of one of the soldiers of the conqueror.

A more simple engine of that description, Fig. 12, consisted of a long and strong perch, armed by a strong iron crow head, and suspended on a moveable carriage. It was employed principally for destroying the parapets of walls, for dismantling the sides of the sheds, under which the rams were worked, and for other similar purposes.

The telleno, Fig. 13, was a machine employed for raising a few soldiers higher than the top of the enemy's wall to ascertain what was going on within them, and sometimes for taking possession of them, and thus facilitating the escalade. In the former instance, it was formed by a great pile driven into the ground, which served as a fulcrum to a long lever which was placed across it, and balanced. At one of its extremities was a light wooden or wicker case, capable of holding a certain number of men, who when the opposite end was drawn down by cords, were raised so as to be enabled to look over the walls or to mount upon them. Others were mounted on carriages.

Such was the artillery of the ancients, or the machines of attack and defence, which the invention of gunpowder has rendered obsolete. In fact few of the machines here described are sufficiently illustrated by the early historians to be able to say with certainty, that the representation is perfectly correct, and some are mentioned, of which only the names remain.

The discovery of gunpowder by Roger Bacon in the thirteenth century, and its application to military purposes by Schwartz, in the fourteenth, caused a complete revolution in this branch of the art of war, and the term Artillery which previous to this discovery, denoted in a general sense, all kinds of missiles, and the machines used in propelling them, applies now to Guns, Howitzers, and Mortars, with their carriages, beds, ammunition and apparatus of all kinds, and the Troops specially appointed for their management.

fig 1.

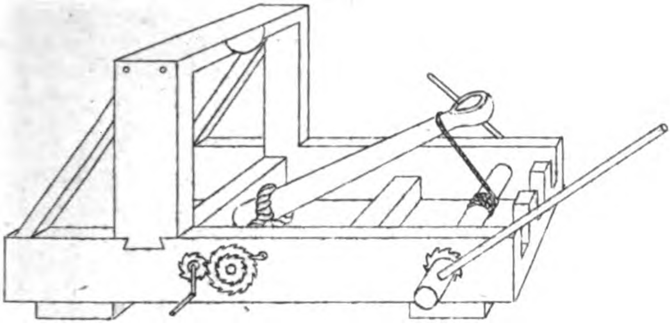
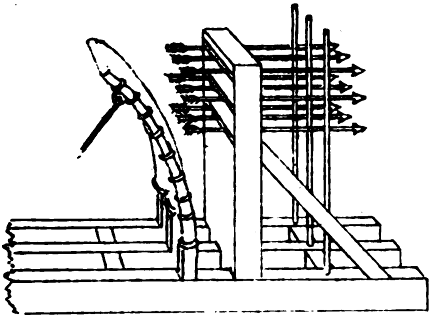


fig 2.



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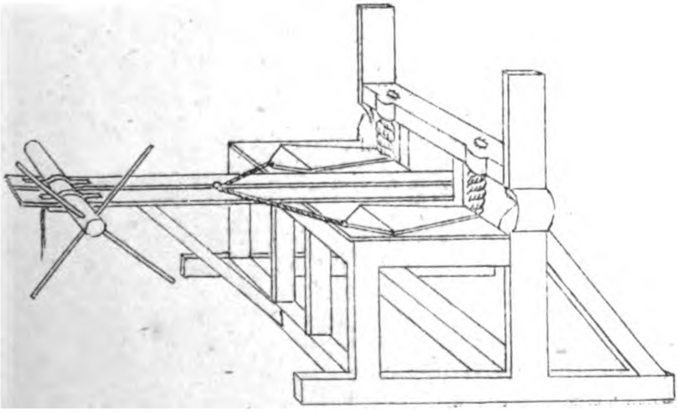


fig 4.

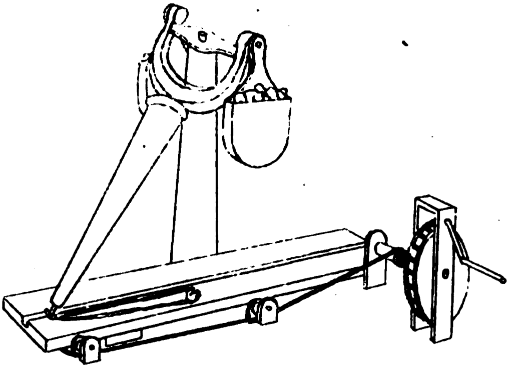


fig 5

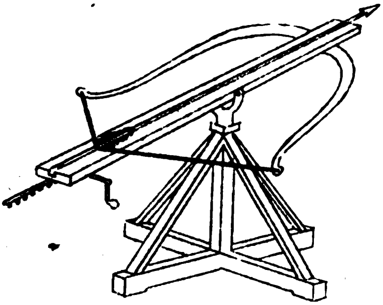


fig 6.

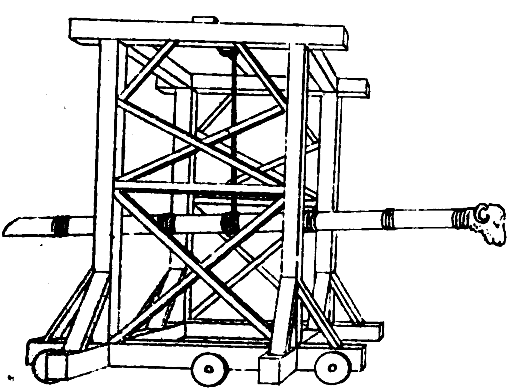


fig 7.

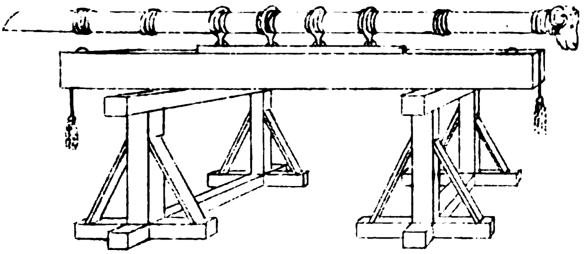


fig 8.

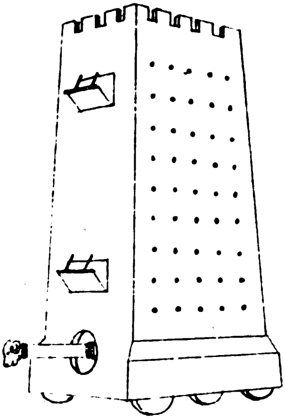


fig 9.

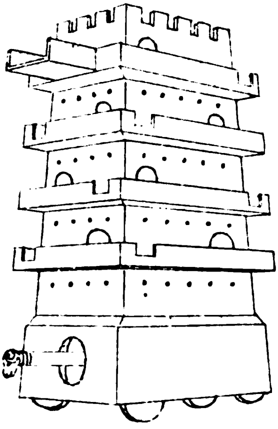


fig 10.

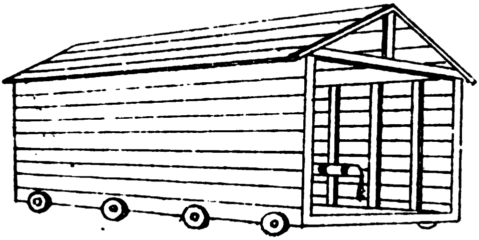


fig. 11.

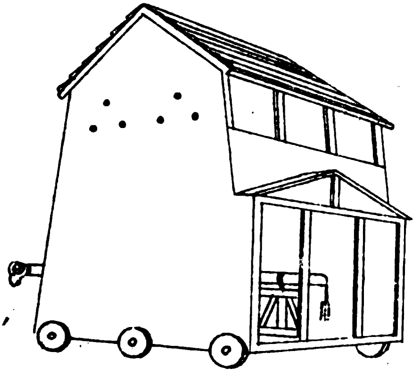


fig. 12.

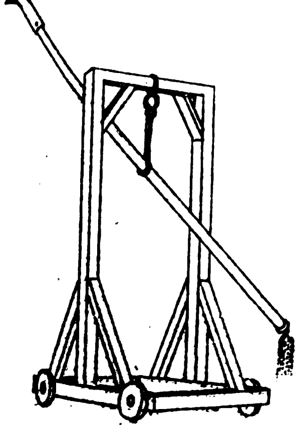
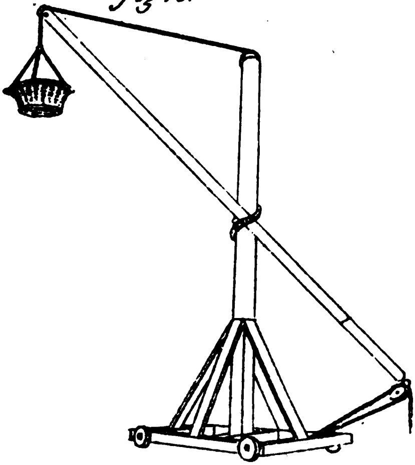


fig 13.



MODERN ARTILLERY.

Cannon were known at least as early as 1312. This is derived, from Arabian writers, who describe the use of Ordnance in 1312 and 1323; Edward III. it is said, was also provided with some pieces of Artillery in 1327, and Père Daniel asserts, that cannon were known to the French in 1338, but they did not employ them it is supposed until 1372. The English appear to have been the first to employ cannon in the Field, although it is said in favour of the Oriental origin of this invention, that Artillery was in much use in the Mediterranean, when it was but little used elsewhere, as by the Venetians against Genoa, in 1330, and by Alphonso XI., in his wars against the Moors.

The 5 cannon used by the English at the celebrated battle of Cressey, in 1346, were placed on a small hill near that village, and contributed greatly to the attainment of that victory.

Cannon, however, were not cast in England, till sometime in the 16th century, viz. brass cannon about the year 1535, and those of iron in 1547. Brass guns have been known of a much earlier date, but whether they were formed of bars, or in what other way constructed is not known.

The first cannon cast in England, was cast at Buxted, in Sussex, by a person named *Howe*, and his man, according to the following tradition, which has been carved upon a stone near the spot, where it is still to be seen.

> " I, John Howe, and my man John,
> We two cast the first cannon."

All the ancient cannon were unnecessarily long and clumsy, and their carriages and appointments, were equally heavy and unmanageable, so cumbrous were the cannon of the 14th and 15th centuries, that they could only be discharged at considerable intervals, viz. two or three times in a day, so that the besieged had sufficient time to repair at their leisure, the damage which they had sustained, and it not unfrequently happened that the pieces burst, and thus did more injury to those who employed them, than to those they were intended to annoy.

GUNS OF FORGED IRON.

They were originally made of iron bars, soldered together, and fortified with strong iron hoops, some of which are still to be seen, viz. one in the Tower of London, and one in the Royal Arsenal at Lisbon. Others were made of thin sheets of iron, rolled up together and hooped, and on emergencies they were made of leather, and plates of iron, * these pieces were made in a rude and imperfect manner, like the first essays of many new inventions. Stone balls were thrown out of them, and a small quantity of powder used on account of their weakness. These pieces had no ornaments, were placed on their carriages by rings, and were of a cylindrical form. When, or by whom they were made is uncertain, the Venetians however used cannon at the siege of Claudia Jessa, now called Chioggia, in 1366, which were brought thither by two Germans, with some powder and some leaden balls, as likewise in their wars with the Genoese, in 1739. Cannon were made use of by the Turks at the siege of Constantinople, then in possession of the Christians in 1394, and in that of 1452, that threw a weight of 100 lbs., but they generally burst either at the 1st, 2d, or 3d shot. Louis XII. had one cast at Tours, of the same size, which threw a ball from the Bastile to Charenton. One of those famous cannon was taken at the siege of Dieu, in 1546, by Don John de Castro, and is in the castle of St. Julia de Barra, 10 miles from Lisbon; its length is 20 feet 7 inches; diameter at centre 6 feet 3 inches, and it discharged a ball of 100 lbs.: it has neither dolphins, rings nor buttons, is of a curious kind of metal, and has a large Hindoostan inscription on it, which says it was cast in 1400.

Formerly the cannon were dignified with uncommon names, for in 1503, Louis XII. had 12 brass cannon cast of an extraordinary size, called after the names of the 12 Peers of France. The Spanish and Portuguese called them after their saints. The Emperor Charles V., when he marched before Tunis, founded the 12 apostles. At Milan there is a 70 pdr. called the Pimontelle, and one at Bois le Duc, called the Devil. A 60 pdr. at Dover, called Queen Ann's pocket pistol. An 80 pdr. in the Tower of London, (formerly in

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* The Swedes used leather guns in the Polish war; in 1630, they were exchanged for iron 4 pdrs. These pieces drawn by two horses, were 4 feet, or 16 calibres in length. Their weight was 625 lbs. and they could fire three rounds in the time, required for one with a musket. Each regiment had two of these guns.

merely a mispronunciation Moolk = Country, not a Lion" [It is really Mallek-i-Maidan. Lord of the Plain]

Edinburgh Castle) called Mounts Meg.+ An 80 pdr. in the Arsenal at Berlin, called the Thunderer. An 80 pdr. at Malaga, called the Terrible. Two curious 60 pdrs. in the Arsenal at Bremen, called the Messengers of bad news, and lastly, an uncommon 70 pdr. in the castle of St. Angelo at Rome, made of the nails that fastened the copper plates, which covered the ancient Pantheon, with this inscription upon it; *Ex clavis trabalibus porticus Aggrippæ.*

Iron guns with brass coats, were found in the fortress of Asseerghur;* and in Burmah, wooden guns are to be seen, strongly bound round with bullock hide. Drawings of the following large Native guns are annexed.

Beejapoor, figure	14.
Bhurtpore, figure	15.
Agra, figure	16.
Beder, fig. 17 and	18.

The great gun at Beejapoor is called "Mullik-i-Mydan," or "*Sovereign of the plain;*" but the natives insist on calling it "Moolk-y-Mydan" or "*Lion of the plain.*" Its muzzle is 4 feet 8 inches in diameter, the calibre 2 feet 4 inches. It was cast at Ahmednuggur in 1540, by a native of Constantinople, named Houssain Khan. Aurungzebe put an inscription on it, to commemorate the conquest of Beejapoor, in 1685, which has led to the mistake of supposing it to have been cast at that time. It is alike curious from its dimensions and history.

Among the Ordnance taken in Agra in 1803, was one enormous brass gun, which for magnitude and beauty, being perfect in all its dimensions, stands unrivalled. This famous piece, which is known in the East by the distinction of "The great gun of Agra," though said to be made of brass, is generally affirmed to be composed of all the precious metals; and that the assertion has some solid foundation, appears from the circumstance, that the shroffs of the city, offered the English commander a lac of rupees, or twelve thousand pounds for it, merely to melt it down. It is difficult to conjecture what use could have been made of such an enormous instrument of destruction, even for the purpose of defensive

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* Thirteen 4-pdr. guns taken at the battle of Delhi, in September 1803, had iron cylinders, or bores, over which it would seem the metal was run in casting the piece, the adherence being so close that no chasm appeared, and nothing but the different colours of the two metals discovered the junction. The iron cylinder, or bore, was composed of four longitudinal pieces of hammered iron, remarkably close, and neatly fitted throughout the bore.

+ Restored to Edinburgh Castle in 18[illegible]..
MONS MEG

warfare; but it is more difficult to conceive in what manner the immense mass of metal necessary for the construction of it, was thrown into a state of regular fusion. Some idea of the piece may be formed from the following sketch and measurement, communicated by a distinguished officer of Artillery, who surveyed it on the spot. The gun is of one cylinder, without ornaments, having four rings, two at the muzzle and the same at the breech.

Calibre of the gun 23 inches; metal at the muzzle 11½ inches, diameter of the trunnions 11 inches; length 14 feet 2 inches; length of the bore 8 feet 8 inches, ditto of the chamber 4 feet 4 inches, diameter of chamber 10 inches, length of the cascable 1 foot 2 inches, weight of the gun 1207½ maunds, one of which being equal to 80 lbs., makes the entire weight 96,600 lbs. The ball of this gun when made of cast iron, weighs 1500 lbs.

In 1806, an account was taken of the Malabar Guns in the different native Forts in the Ceded Districts, and amongst them the following long and curious pieces of Ordnance were found.

PLACE.	Length.		Diameter			REMARKS.
			at the breech.	at the muzzle.	of the bore.	
	feet.	*ins.*	*ins.*	*ins.*	*ins.*	
Koolakoota....	14	1	16	13	6$\frac{2}{01}$	
Sedhout.......	18	,,	32	32	21	
ditto.........	16	,,	18½	19½	12	
ditto.........	23	,,	23	24	18	
ditto.........	22	9	24	23	13½	
ditto.........	12	7	15½	14	9	
ditto.........	21	,,	24	24	14	
ditto.........	21	,,	24	24	14	
ditto.........	22	10	30½	33½	24	
Gurrumcondah..	,,	,,	,,	,,	,,	

The dimensions of the guns at Gurrumcondah were not taken, but the following remarks were entered in the return sent in.

"No. 1 is country cast, has a large flaw in the muzzle " 1½ inch deep, 6 inches long, and nearly the diameter of the " bore. No. 2 appears to have been a one-pounder, is burst " at the muzzle, and has a false muzzle of brass put on. No. " 3 appears to have been a one and a half-pounder, burst at " the muzzle and hooped with iron. No. 4 burst 2 feet 3 " inches from the trunnions and hooped with iron. No. 5 " honey combed, and a large piece out of the muzzle, and the " vent enlarged to 6-10th of an inch wide. No. 6 burst at " the muzzle and hooped with iron. No. 7 vent enlarged to " 1 inch. No. 8 burst 2 feet from the trunnions and hooped " with iron. No. 9 burst 1 foot 6 inches from the trunnions " and hooped with iron. No. 10 honey combed and vent en" larged to 8-10th of an inch wide. A brass 5 pdr. gun is " also burst at the muzzle and hooped with iron."

The French in Egypt and in Spain, have discovered a great number of these old guns, which they destroyed on account of the iron, which was of an excellent quality.

In the Museum of the Royal Artillery School at Strasburg, four forged iron guns are to be found of great length, but small calibre. Two of these pieces are made to load at the breech, and they have small plates of iron, that move in a groove, and by which the vent can be covered, either during the loading of the gun, or to protect it from the rain.

The slender knowledge of the means of obtaining good forged iron, and the want of proper workmanship, to enable the necessary forms and dimensions being given, caused the fabrication of those guns to fall into disuse, sometime in the 14th century. It was again, however, restored in the 18th century, both in France and Spain. Guns were made of massive forged iron, and afterwards bored, these attempts succeeded in great part as to their principal object, and in some way justified the opinion, that guns of forged iron of less thickness; and consequently less weight, than guns of cast iron, lasted longer and resisted better the action of gunpowder.

GUNS OF CAST IRON.

The earliest time furnaces were used for fuzing iron, must have been about the 15th century. It is asserted to have been discovered in the provinces of Germany, bordering on the Rhine, and from whence it must have found its way into England.

It is probable that casting shot was the first use made of this art, and later when more practised in this kind of work, it was extended to the casting of pieces of Ordnance.

The importance of this discovery may be easily imagined, there was then nothing to prevent the multiplying the number of guns, which in forged iron were so expensive (at least the large calibres) and cost so much time and labour, and for which skilful artizans were required. By degrees the larger calibres also, were dispensed with, as the cast iron projectiles also no longer required enormous dimensions, to bring them up to a certain weight. Finally the art of casting, soon introduced greater simplicity and uniformity in the material for the Artillery.

However, the use of cast iron ordnance shewed that flaws were often found in the thickness of the metal, and that they were brittle and dangerous to use, it was necessary, to resist the expansive force of gun-powder, to give them a great thickness of metal—then came the inconvenience of heavy cumbrous ordnance, difficult to take to the field. Cast iron guns although less subject to oxidation than forged ones, were nevertheless soon attacked by rust, which enlarged the calibre and augmented its brittleness. In Sweden where the iron is of an excellent quality, cast iron is even used in the construction of field pieces.

In 1811, Scharnhorst writes, " a dislike to cast iron guns " caused some experiments to be made, before some iron " mortars required for service were permitted to be cast. " Some iron 6 pdrs. were cast of the same weight, as the " common brass ordnance, and the same length. They were " proved with high charges. The cast iron guns burst when " the charge gradually amounted to 6 pounds. The brass " guns burst with a charge of 11 pounds, they stood all the " charges inferior to the above."

What is most annoying in such experiments, is that it happens sometimes, that a cast iron gun which has stood a heavy charge without any alteration, will afterwards burst with the same charge. These accidents do not however occur with new guns, but have frequently with old guns, which were proved originally 30 years previous.

It is a remarkable thing that cast iron guns are more apt to burst in cold than in hot weather.

BRASS GUNS.

The objections made to cast iron guns, naturally lead to the search of another metal, better calculated to be used in casting ordnance ; brass, which after soft iron, is the hardest metal, and which was known in casting for ages, naturally attracted attention, and preference was given to it, but it was soon found out that the hardness of brass, was far from sufficient to resist the shocks of iron shot, it was also known that things cast of pure brass, often contained flaws, cavities and other vicious effects of casting.

In Sir Robert Comyn's History of Western Europe, it is said, that on the 31st December 1494, Charles VIII. King of France, and his army entered Rome, by the Porta del Popolo.

" The Romans beheld the cavalcade with fear and admi-
" ration, but what chiefly struck them, were the 36 brass
" cannon, mounted on carriages drawn by horses, which
" passed with almost equal facility over plain and rough
" places. Their greatest length was 8 feet, their weight
" 6000 pounds, and they were capable of discharging a
" ball of iron, of the bigness of a man's head. After the
" cannon came the culverins, half as long again but of
" smaller calibre, last came the falcons, some less, some
" greater, the least of which could launch forth a ball the
" size of a citron. All these pieces of Artillery were mount-
" ed on carriages, constructed of 2 thick beams, into which
" the trunnions were inserted, and they were poised so as
" to be raised, or depressed, the better to direct their aim.
" The smaller had 2 wheels, the large 4 ; but of these, 2
" could be removed at pleasure, when the guns were not
" required to be set in motion. The drivers had such com-
" mand over the horses, by their whips, and voices, that on
" level ground, the speed of the Artillery, was not inferior
" to that of the Cavalry."

The men employed in digging the foundations for the new Trades Hall, at Beaum, in Burgundy, lately found a brass cannon 1060 lbs. in weight. It is above 9 feet in length; the exterior is of an octagonal form, and on the upper part of the barrel are a salamander surmounted by a crown, the device of Francis I. an anchor, and near the touch-hole are two interwoven initials FR (François Roi) in Gothic characters. The piece is of a calibre for $3\frac{1}{2}$ pound shot and is covored with an uniform coat of rust. It has been deposited in the Town-Hall at Beaum.

BRONZE GUNS.

It became then necessary to add some other metal, for it was well known, that generally the mixture of 2 metals, is harder than each metal separately, and a mixture called bronze was then had recourse to, which was a mixture of tin and copper.

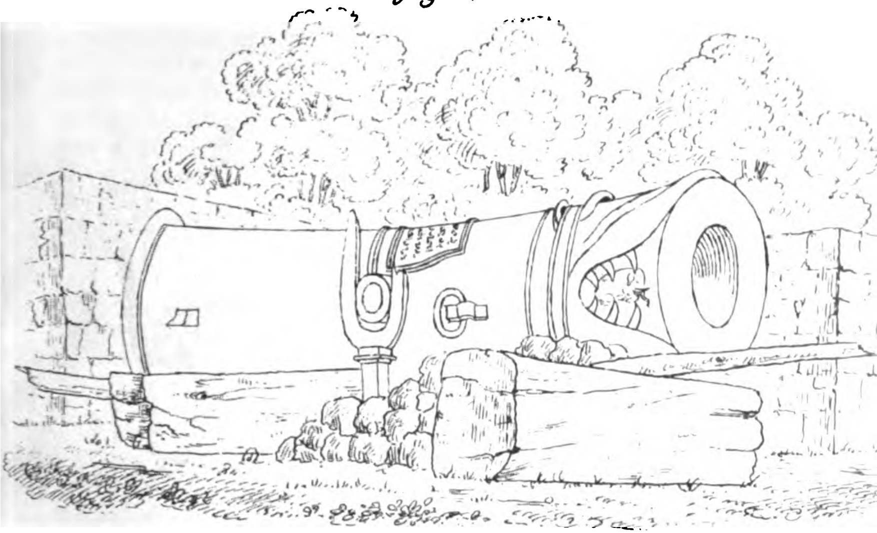
The employment of bronze in the fabrication of ordnance soon led to more regularity, more simplicity and more conveniences in the construction of ordnance, and before the end of the 15th century, bronze guns were distributed over the principal states of Europe.

Trunnions and cascables were added to them. To ascertain the strength of the new ordnance 2 cast at Lyons were proved, they fired quick more than 1500 rounds each, with charges of $\frac{1}{3}$ and $\frac{1}{2}$ the weight of shot, without the chase or bore being the least damaged. The vent of one was scarcely enlarged, the other was a little.

NEW METAL FOR GUNS.

It has been asserted that, some Russian guns have been cast, from a mixture of brass, tin and iron. One of these a heavy gun, had stood efficiently the test of 20,000 rounds, and that another field piece could not be destroyed.

fig 14.

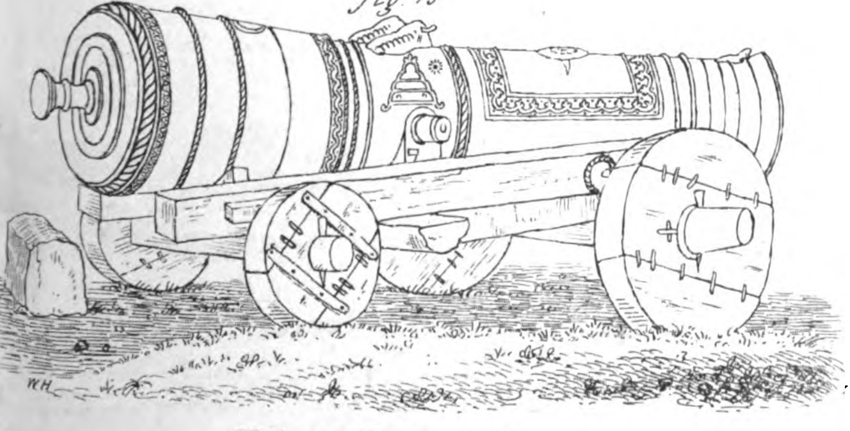


Beejapoor Gun.

	ft. in. th.		ft. in. th.
Length of Gun	14 . 2 . 2	Diam^r of Breech & Muzzle	4 . 4 . 9
— " — Bore	7 . 11 . 7	— " — Bore	2 . 4 . 5
— " — Chamber	4 . 8 . 5	— " — Chamber	1 . 4 . .

Weight of Gun — 41 tons
— " — Shot 3087 lbs

fig 15

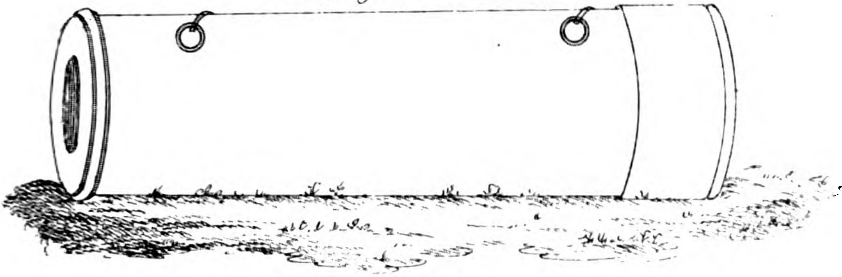


Bhurtpore Gun

	ft. in. th.
Length of Gun	15 . 3 . 0
Diam^r of Breech	3 . 3 .
— " — Muzzle	2 . . .

Artillery

fig 16.

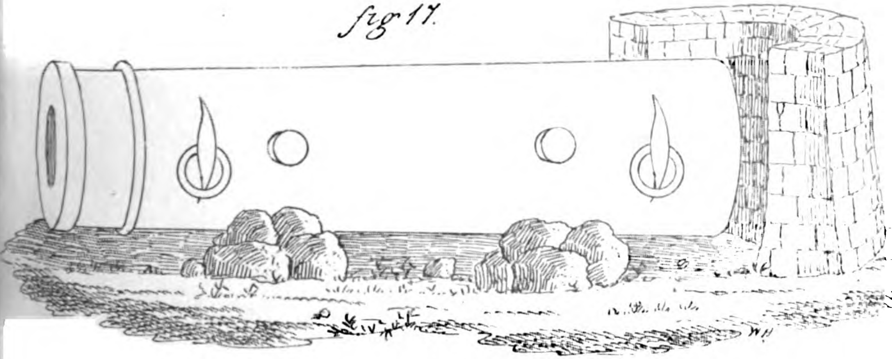


Agra Gun

	ft in th		ft in th
Length of Gun	14. 2. 0	Diam^r of Bore	1. 11. 0
— . — Bore	8. 8. 0	— . — Chamber	. 10. 0
— . — Chamber	4. 4. 0	— . — Muzzle	3. 10. 0

Weight of Gun 4·3$\frac{1}{8}$ tons
Weight of Shot 1500 lbs.

fig 17.



Beder Gun

	ft in th		ft in th
Length of Gun	14. 9. 0	Diam^r of Muzzle	3. 7. 6
Diam^r of Bore	1. 7. 4	— . — Breech	3. 10. 8

Weight of Shot 964 lbs.

Artillery.

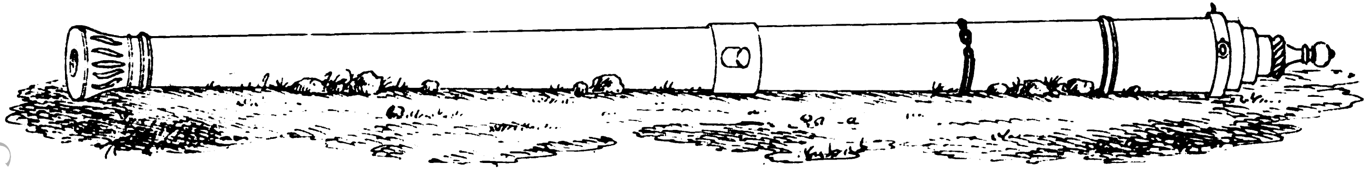


fig. 18

Beder Gun.

	ft.	ins	ths.
Length of Gun	28.	5.	7½
Diam: of Bore Vertically	.	5.	9
do — do Horizontally	.	5.	7¾

Weight of Shot 24 lb.

MODERN IMPROVEMENTS.

1. Brass Ordnance does not appear to have been ameliorated since the time of Vauban and St. Remy; but iron ordnance then not made use of in a siege, and not to be relied upon, has now certainly been brought to great perfection. and promises to be even more so; yet these durable qualities in Cast Iron though so peculiarly adapted to sieges have been almost entirely overlooked by every military writer.

2. The arts have given smoother surfaces, and more mathematical precision to the forms of ordnance, the Bore, Shot and Shells.

3. The cylinders of iron guns support the most severe firing without altering their form. From 4 to 500 rounds in the 24 hours with a large charge can be fired from an iron 24 pounder, while at the same time, not more than 100 to 120 rounds can from the brass, and even with that number, the bore is injured.

4. The costliness of Brass ordnance was the reason of the substitution of iron in its place in England, and the proofs which the latter undergoes, to ascertain its strength and tenacity, have brought it to its present perfection.

5. Though iron cannon have been used in the British Navy, and for Garrison service, at least a century past, yet the highly perfected state of the English iron ordnance on any enlarged scale, does not bear date much farther back than the year 1797.

6. It is said that the Carron Company (in consequence of their guns bursting during the American war) were excluded from furnishing guns to the English government, they however supplied the Carronades (fired with small charges) and in the meantime they furnished the East India Company; when upon these guns being proved at Woolwich, it was noticed that they stood the proof better than the Ordnance of other founders, and were finished in every respect in a superior manner, which circumstances being represented to the Board of Ordnance they were again admitted to a share of the government contracts, and they have continued these supplies ever since. The heavy iron Ordnance is now paid for, at the rate of, from 18 to 20£ per ton, and as the average price of brass Ordnance is about

180£ per ton, for pieces above 10 cwt., the expense of the latter to the expense of the former is at least nine to one; an economy of infinite importance to any State, but more particularly to one with so extensive a Navy, and such numerous colonies as Great Britain.

7. The next idea that naturally presents itself, is, why, if the heavy Ordnance be so much superior to, and cheaper than the brass, should not iron cannon be also adopted in the field service, and substituted for the lighter brass pieces? since there can be no doubt, if they resist the necessary proofs, they will be found superior in every respect to the brass, in their durability and unchangeable form of their bore.

8. To understand this question, there is one point to be taken into consideration which does not occur to the heavy iron ordnance: it is, that as iron field pieces would not have the same proportionate thickness of metal, as the heavy iron guns, there would exist a necessity for these light iron ones being of such superior tenacity, as to stand the most severe proofs.

9. It appears that the Carron Company do not entertain the smallest doubt that they could cast *Iron Field Pieces* of precisely the same weight* as the brass ones now in use, which iron guns they would warrant to stand whatever proofs might be considered necessary; but as the workmanship on the smaller calibres is proportionately more than that employed on the large ones, and as in consequence of the superior refinement of the metal required in this case, a greater loss of it in the furnace would take place; therefore 56£ per ton, being at the rate of 6*d.* per ℔. is the price at which the Company would cast these guns; now as the brass field pieces cost about 200£ per ton, the proportionate expense of one to the other would be nearly as one to four, or in other words, iron field pieces may be cast for about one-fourth the expense of what the brass ones now cost.

10. In considering this question, however, it is necessary to state, though brass Guns will be found to be nearly useless for the purpose of Sieges, yet this is by no means the case as to brass pieces for field service, which are much more durable on account of the smaller quantities of powder fired from them and the inferior weight of their shot, these pieces

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* A cubic foot of gun metal weighs 549℔s., that of cast iron 464℔s.

being equal to several actions; it is nevertheless observed that their cylinders are scored considerably by the use of canister shot; and that when spherical case shot burst in them they are oftentimes rendered unserviceable, and also that they are gradually more or less damaged in proportion to their being fired, until for these reasons, they become useless by the enlargement of their bores; whereas iron field pieces as to their bore, would remain unchanged even after 2 or 3000 rounds, consequently in every stage of their use they would be found to be infinitely better pieces of ordnance than the brass ones.

In the last sieges in Spain, brass guns could never support a heavier fire than 120 rounds in 24 hours. and were rarely used to batter, at distances exceeding 300 yards: whereas with iron guns, three times that number of rounds was fired with effect, from three times the distance for several consecutive days, without any other injury than the enlargement of their vents. At Woolwich, iron 32 and 24 pounders have been fired (partly double shotted) 10 rounds in 8 minutes, to the extent of 100 rounds each without injury: and accurate practice has been made at 750 yards with 24 pounders which fired 200 rounds in five hours and 2 minutes. Still brass guns are sufficiently strong for as much firing as can possibly be required of them, in the hottest general action, while their superior lightness renders them more fit for the field.

11. The prejudice of the French Artillery against the employment of iron guns is well known. At the siege of Antwerp in 1832, the whole of the French battering guns were of brass of peculiar beauty. The fire of brass Ordnance cannot be so quick, or constant, as that of iron pieces, and on the present occasion the discharge of the French batteries was by no means rapid. The fire was severe and efficacious, and yet not more destructive or rapid than might have been expected from the great quantity of pieces in battery, and the number of days they were employed; the whole number of rounds fired amounted to above 63,000. Taking the number of pieces to have been 105 and the number of days 19, this will give about 3300 for the whole per day, 600 rounds for each piece for 19 days and 31 rounds for 24 hours, or not 1 shot in 40 minutes for each gun. The number fired by the British battering guns on various occasions was rarely less than 100 or 90 per day.

12. The immense superiority of Iron over Brass material for battering trains received an additional corroboration from this siege. The predeliction of the French for brass battering train may probably be accounted for, from their having no Iron founderies at all to compare with that of the Carron Company.

13. Very efficient Brass battering guns may however be made, the "Aide Memoire" speaks of four 24 pounders cast at Seville in 1786, each of which was fired with unfixed shot and 8 pounds of powder 5300 times, without injury to the bore or vent, and were subsequently used at the late blockade of Cadiz.

14. Some few trials have been made at Woolwich with guns of wrought Iron, but they have not succeeded from the difficulty of welding and hammering in an uniform manner so large a body while heated; besides the greater price of such ordnance, even if well made, would be a bar to its adoption.

15. In the rapid growth of scientific improvement, which during the last 35 years, has extended through every branch of the Military establishment, there is nothing more remarkable or honorable to the national ingenuity and energy than the changes which have been wrought in the organization of the Ordnance Service. These changes are such as to render the British Artillery absolutely the very finest and best, an example for the envy of the Military powers of the Continent, and a model for the avowed imitation of even that nation which has heretofore been held to excel all others in the qualities of martial science. It has hitherto been admitted by universal consent, that of all the people of Europe, the French have habitually in their national character, shown most original genius and aptitude for military affairs; and it is therefore not a little gratifying to the British Artillerist to observe these acknowledged masters in the art of war, these boasted instructors of our earlier years, surpassed in their own favorite vocation and reduced to become in their turn, the pupils and imitators of our military knowledge and invention. This practical homage on the part of the French to the decided superiority of our Artillery, is a circumstance publicly and candidly admitted by some at least of their own writers. A memoir by the Chef de Battalion Parizot a skilful Officer of the French Artillery, details six essential advantages in the British system over that of his countrymen;

and Dupin, who quotes this Memoir, adds in a note, the following testimony of a French General Officer, who attended the Review of the Allied armies of occupation in France in 1818. "I'ai observé avec beaucoup d'attention, "les manœuvres d'Artillerie des diverses puissances ; j'ai "ete frappé de la beautè, et du luxe de toutes les troupes qui "composaient l'armée, de l'ordre, et de la precision de leurs "mouvemens et de leurs manœuvres ; mais les Anglais "sont les premises sous tous les rapports."

16. All the improvements which have raised the British Artillery to its present state of perfection, are, as already observed, the work of our own age. At the commencement of the late war in 1793, the various Ordnance equipments, as well as the whole composition of this branch of Military service, were of the rudest kind, and on the worst organized and most defective plan. The insufficiency of the whole system, indeed was palpably betrayed whenever a force was required to take the field. The guns were dispersed among the Infantry, at the rate of two pieces to a battalion, thereby rendering it impracticable to employ them for their legitimate purpose—the concentrating a powerful fire of numerous guns, on any important point. They were also horsed in single team, which needlessly both lengthened the column of march and diminished the power of draught. The drivers were on foot with long whips, as were also the gunners. The ammunition was packed in large rough deal boxes; the waggons which conveyed it, were heavy and ill-constructed, and the whole equipment was so cumbrous, that it was impossible for the train to move out of a foot-pace, except for a very short distance: and if increased speed were attempted before the enemy, the men came into action breathless, and unable to serve their guns.

17. But before the commencement of the Peninsular war was established the present beautiful system of Field Artillery. The battalion guns were abolished, and the Artillery was brigaded distinct from the Infantry and Cavalry with which it served, in divisions of six pieces each, so that the power of one or more of these powerful batteries could be readily concentrated on any given point. The whole of the equipment was simplified and lightened to such a degree, that the batteries could move at a gallop ; the ammunition packed in boxes, on the limbers and cars, was always up with the guns; a system of manœuvres for Artillery in the field was introduced, which gave order and precision to their own

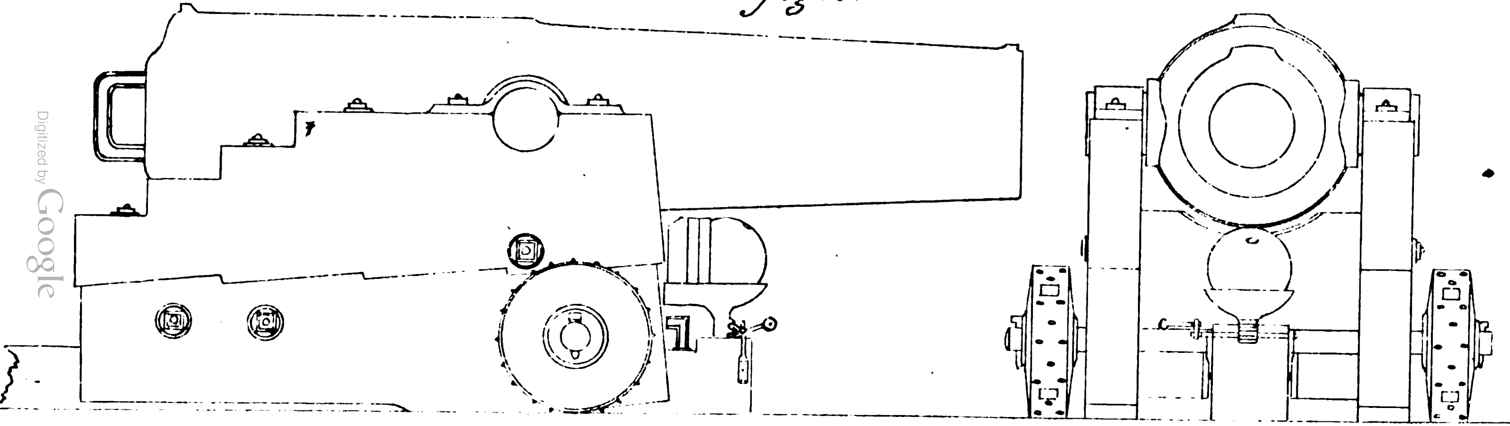
movements and established uniformity between them and the troops of other arms. The advantages of this system are ably described in the following observations of a General Officer of the French Artillery, who was present at the final review of the allied army of occupation in France.

“ La cavalerie soutenue par des masses d’infanterie, etant
“ sur deux lignes sur la plaine entre la Selle, et l’Ecaillon,
“ on vit á la fois se detacher des differens corps, plus de cent
“ bouches à feu d’artillerie à pied et à cheval ; et se porter
“ avec la même vitesse, a cent toises en avant de la premiere
“ ligne de cavalerie. On commença l’affaire par une can-
“ nonade qui resemblait à un feu de file. Les mouvemens
“ des batteries, et les manœuvres des bouches à feu s’execu-
“ terent avec beaucoup d’ordre et de precision. La facilitè
“ avec laquelle on met et ote l’avant train ná pas echappé
“ aux Officiers d’Artillerie. Il est souvenu un accident à
“ une batterie à pied, qui arrivait au galop par un chemin
“ trés escarpé. Ayant rencontré une caléche qui fermait le
“ passage, elle n’hesita pas, dans la crainte d’un retard, à
“ se precipiter dans le champ à gauche. Une seule piece
“ fut renversée avec les cannoniers dont un fut blessé. Elle
“ fut relevée en un instant, et rejoignit sa batterie. Il y eut
“ successivement deux charges de cavalerie par les deux
“ lignes, qui repoussées, vinrent se rallier l’une derriére l’autre.
“ On vit les cannoniers emmenant les avant trains, abandon-
“ ner les pieces, et revenir aussitôt aprés la charge, recom-
“ mencer la feu. Le passage de l’Ecaillon, defendu par
“ l’armée ennemie qui occupait les villages, les ponts, et
“ tous les points importans de la position, donna lieu aux
“ dispositions et aux manœuvres que necessite une opera-
“ tion de cetta importance. Le passage forcé, l’armée en-
“ nemie tournée par sa gauche, pressée par les allies, fit sa
“ retraite, defendant le terrain et les villages, pied a pied
“ jusque sur les hauteurs du camp de Famars. L’Artillerie
“ à suivie les mouvemens des divisions, dans la vallée diffi-
“ cile de l’Ecaillon, et dans la plaine au-delà (malgré les
“ obstacles) jusqu’au pied des hauteurs de Famars, arrivant
“ sur le terrain en meme temps que les troupes ; cette posi-
“ tion est couverte par un ravin profond et difficile, qu’elle
“ a franchi comme la cavalerie. Quelques voitures ont
“ ver séc, mais ont été promptement relevées. Notre artillerie
“ n’aura surmonté cet obstacle qu’ avec beaucoup de temps,
“ et de travail.”

Artillery.

Paixhan's Large Gun.

Fig 19.



	ft	in	th		ft	in	ths
Length of Gun	8	4	0	Diamr of Breech	2	1	0
„ Bore	6	6	0	„ Muzzle	1	5	5
„ Chamber	1	3	0	„ Bore		10	0

Weight of Shell 150lbs.

Artillery.

Genl. Millar's Naval Gun & Carriage.

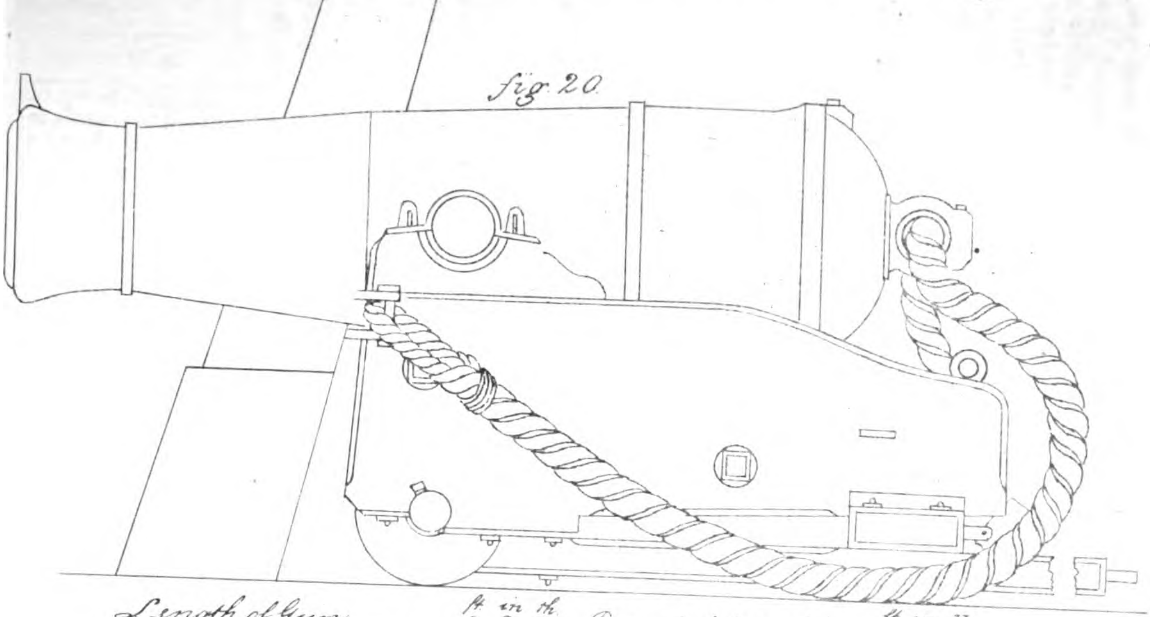


fig. 20

Length of Gun ———— ft in th 9 . 2 . 0
Diamr. of Bore ———— 1 . 0 . 0
Weight of Gun 5 tons

Diamr. of Breech ———— ft in th 2 . 2 . 2
———— Muzzle ———— 1 . 11 . 2
Weight of Shell 122 lbs

Weight of Shot 23

18. We have also the *Canons a Bombes*, a la Paixhans, Howitzers of greater length of bore than ordinary, and also with less windage fig. 19. The most effective proof of the value of M. Paixhans improvement, against fortification, is the practice which was carried on by Col. Sir Alexander Dickson in 1814, with carronades and howitzers, at a range of 4 and 500 yards against M. Carnot's wall covered by his counter-guard, and strengthened in a length of twenty feet, by an additional buttress at each end, of four feet square, when in three hours and a half firing, a practicable breach was effected with eight 68-pounder carronades, and six 10 inch long howitzers in a wall of the same height with the counter guard and ninety feet from it. This was not however considered any thing particular in English practice, but it was asserted at the time by foreign officers of distinction, that the wall could not be breached and that it had been attempted in vain by the Artillery of the Principal Powers in Europe.

19. The practice in the British Service with the Paixhan guns has not however been carried to an equal extent, as in the French: but with the 12 inch gun of 90, cwt. 31 qrs. 4lbs. weight of hollow shot about 125lbs., windage ·15 inches, charge 12lbs., only a range of 1300 yards has been the result.

20. The number of men employed with the guns of Col. Paixhan was fifteen, being that required for a 36-pounder. The English gun mounted on board ship fig. 20 was worked by six men with ease, and it recoiled from four and a half, to five feet.

The following tables contain some particulars respecting General Millar's Guns á la Paixhans.

CALIBRE OF		Windage.	Length of Gun.	Length of Chamber or altitude of Frustrum of cone.	Powder containing in shell.	WEIGHT OF					Number of lb. of Gun to each lb. of Projectile.	
						Projects.		Gun.	Carriage.	Slide.	Hollow.	Solid.
Gun.	Projectile.					Hollow.	If solid.					
in.	in.	in.	ft.in.	in.	lb.	lb.	lb.	cwt.	cwt.qr.			
12	11.85	.15	9.2	16	9	122	234	100	17.2		91	48
10	9.88	.12	9.4	15	4	72	135	84	13.2	25.2	130	70
8.05	7.95	.1	9.2	13.25	2½	33½	70	60	„		200	96

Practice with Shells from the above Guns.

12 Inch.				
Charge.	Elevation.	Time of flight.	Range.	Remarks.
lb			yds.	
10	1¼°			
11	1°		400	
	¾°			
		2¾″	750	
		2¾″	750	Medium at 2°
	2°	2¾″	843	Range 806 yds.
		3″	818	Flight $2\frac{13}{20}$″
		3″	872	
		4½″	1032	
		3¾″	1000	Medium at 3°
12	3°	4″	976	Range 1030 yds
		4″	1087	Flight 4″
		4″	1060	
		5¼″	1233	
		5″	1247	Medium at 4_{0}.
	4°	4¾″	1141	Range 1232 yds
		5″	1210	Flight $5\frac{1}{10}$″
		5¼″	1330	

10 Inch.				
Charge.	Elevation	Time of flight.	Range.	Remarks.
lb			yds.	
	1°		400	
		3″	856	
		2¾″	816	Medium at 2°
	2°	3″	782	Range 775 yds.
		3¼″	795	Flight $2\frac{9}{10}$″
		2½″	630	
		..	1027	
		..	1006	
8	3°	..	970	Medium at 3°
		..	1150	Range 1027 yds
		3¾″	1034	Flight 4″
		4¼″	1020	
		..	1215	
		.	1300	
		..	1237	Medium at 4°
	4°	..	1107	Range 1231 yds
		4¼″	1280	Flight 4¼″
		4¼″	1250	

21. These guns, with a substitution of the gomer or truncated cone chamber, with hemispheric bottom, for a cylindrical chamber with conical junction to the cylinder of the gun, have been introduced into our service by Lieutenant General Millar, whose improvements in the carriage department, had brought the material of our Field Artillery to that high perfection, which has called forth the admiration of all Europe, and has led the French to adopt it almost in every particular, the only important difference being the retention of the pole.

22. *Table of the Iron Guns in use with the different powers in Europe.*[*]

NOMINAL NATURE OF GUN.	NATION.	Calibre of Guns.	Windage	Weight of Shot.
		Inches.		Pounds.
48 Pounder	France	7.2835	One line and a half = ·13324 of an English inch.	54.3375
36 Pounder	Sweden	6.9947		45.4293
	Denmark	6.9163		43.8887
	France	6.8811		43.2108
	Russia	6.8390		42.3958
32 Pounder	England	6.4100		34.7751
30 Pounder	Russia	6.4349		35.1911
	France	6.4846		36.0312
24 Pounder	Sweden	6.1107		30.1048
	Denmark	6.0437		29.0362
	France	6.0068		28.7511
	Holland	5.9745		28.0269
	Russia	5.9738		28.0177
	Austria	5.9127		27.1472
	Spain	5.9072		27.0699
	Prussia	5.8705		26.6557
	England	5.8230		25.9026
18 Pounder	Denmark	5.4930		21.6516
	France	5.4630		21.2919
	Russia	5.4276		20.8694
	Holland	5·4076		20.6270
	Austria	5.3719		20·2182
	England	5.2920		19.3062
16 Pounder	France	5.2633		18.9843
12 Pounder	Sweden	4.8508	One Line.	15.2765
	France	4.8190		14.8889
	Denmark	4.7765		14.4905
	Russia	4.7414		14.1685
	Holland	4.7204		13.9777
	Spain	4.7080		13.8643
	Austria	4.6931		13.7303
	Prussia	4.6758		13.5764
	England	4.6230		12.1133

[*] The windage allowed by the several nations, and even of the same nation, varies; it is, therefore, assumed to be one line and half French, for all guns above 12 pounders; and one line for 12 pounders, and all inferior calibres. In future wars it will, no doubt, be at least this. The weight of shot which English guns might project, if the windage were similarly reduced, is also given to facilitate comparison.

23. Many years ago, satisfactory experiments were made, to establish the feasibility of reaming out the bores of iron guns to the next superior calibre. This appears by the following extracts from proof reports, dated Woolwich, 18th April 1776.

" A 12 pounder, weight 29 cwt. 1 qr., length 7½ feet, was
" bored up to an 18 pounder, and then weighed 28 cwt. 1 qr.
" An 18 pounder weight 40 cwt., length 9 feet, was bored
" up to a 24 pounder, and then weighed 26 cwt. 1 qr. 4lbs.
" Eleven rounds were fired from each gun. The 12 pounder, charged with 9lbs. of powder and nine 18 pdr. shot.
" The 18 pounder with 12lbs. of powder and ten 24 pdr. shot.
" They were subsequently proved, in the usual manner, by
" the proof master, and again fired 45 times with the above
" charges and the same number of shot, that is, as many as
" they could contain. The guns were then carefully searched, and not the least flaw or defect could be discovered in
" either of them. This experiment did not lead to any immediate result."

24. The invention of Shrapnell Shells, or Spherical Case Shot which has hitherto been imperfectly comprehended by some even in our own Service, and absolutely baffled the enquiries of the French, is however now better known, and in future wars it is probable, that these shells will be more highly prized than they have hitherto been, because they will be adopted by our enemies, and we shall practically feel their effects. Spherical Case Shot is a most formidable weapon, either in Field engagements or in the attack and defence of fortresses, at long ranges it is a superior substitute for either musquetry or canister shot.

Extract from the Despatches of the Duke of Wellington, by Lieut. Colonel Gurwood, vol. 9.

General the Earl of Wellington, K. B. to the Earl of Liverpool.

MY DEAR LORD, *Niza*, 16*th April*, 1812.

I enclose Sir Thomas Graham's opinion on the Spherical Case Shot; since I wrote to you last on the subject, I had opportunities of hearing accounts of the effects of these shot, on the garrison, during the siege of Badajoz. Several wounded in the hospital have declared, that they were wounded by these shots; and I learn from a person who was in the town during the siege, and had opportunities of hearing the French Officers talk, that this description of shot had great effect, and that it was quite impossible to keep the men at their guns, or at work when they were fired.

(Signed) WELLINGTON.

25. Whatever merit is due from the introduction of Rockets, as a military projectile in Europe, is altogether due to the English and of them to General Sir Wm. Congreve of the Artillery, to whom very many improvements are owing.

26. During the siege of Cadiz, the French fired shells into the town from 2 large mortars at a distance of 4000 yards. Their calibre was much the same as our 13 inch mortars, but in their internal construction they differed materially: the largest took 40 lbs. of powder for its charge, and was nearly 8 feet in length. A great deal of lead was run into the shells: they seldom burst and when they did so, their explosion was inconsiderable. One of these mortars is to be seen on the parade of the Horse Guards St. James' Park. The blockade (by land) of this city is memorable; it was commenced early in the year 1810, and notwithstanding the utmost efforts on the part of the French army, directed as they were by the consummate skill of their best engineers, the city successfully resisted. The complete change of affairs, which succeeded the battle of Salamanca in 1812, and the victorious progress of Lord Wellington, in the centre of Spain, rendered it necessary for the French to withdraw from Andalusia; and so rapid was the retreat of the blockading army, that a large portion of their Artillery was left behind.

27. As a mark of gratitude and respect, one of the captured mortars fig. 22 was presented to the Prince Regent, who ordered it to be mounted and placed in its present situation. It is supported on a finely executed allegorical base, emblematic of a celebrated event in the early fabulous history of Cadiz—the destruction of the monster Geryon, who had established himself in the island, where the ancient city of Gades afterwards stood. This enterprise formed one of the famed labours of Hercules. The pedestal on which the monster is placed, has several inscriptions. The principal one is as follows:—

" To commemorate the raising of the siege of Cadiz,
" in consequence of the glorious victory, gained by the
" Duke of Wellington
" over the French near Salamanca, on the 12th July 1812.
" This mortar, cast for the destruction of that great port,
" with powers surpassing all others
" and abandoned by the besiegers in their retreat,
" Was presented, as a token of respect and gratitude, by the
" Spanish Nation,
" To His Royal Highness the Prince Regent."

28. The largest mortar ever employed against the defences of a place, was the iron 24-inch mortar, used at the siege of the citadel of Antwerp in 1832, fig. 21. The dimensions of this mortar stated in French weights and measures, are as follows :—

Diameter of the shell............	24	inches.
Thickness exclusive of culot......	2½	„
Weight of empty shell.............	916	lbs.
Powder contained in shell........	99	„
Weight of shell full charge........	1015	„
Calibre massive..................	1666	„
Weight of mortar metal..........	14,700	„
Weight of bed wood............	16,000	„
Powder in chamber (full)........	30	„

29. The monster mortar hitherto appears remarkable only for the extremely bad shells which were cast for it, and the time taken in loading it. Our 13 inch shells stand the explosion of 20 or 30lbs. of powder, whilst the monster was served with only twelve and a half.

30. It having been announced that an experiment would be made on the 24 inch mortar on the heath of Braeschaet, a number of Generals and Officers of all arms proceeded to that village. The previous experiments made at Liege had not succeeded, either from some defect in the shell, or in the mode of firing. It had been tried with the usual wooden bottom, as well as with a wad of twisted straw, but with one or two exceptions, the projectile burst at the moment of quitting the piece. This was attributed to a want

Artillery.

Monster Mortar:

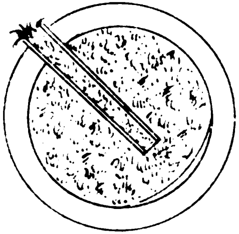
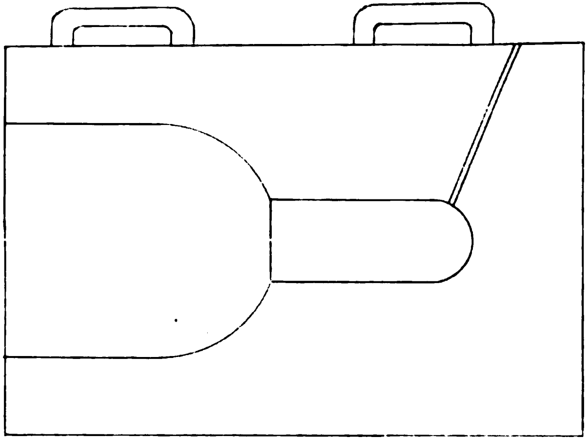


fig. 21.



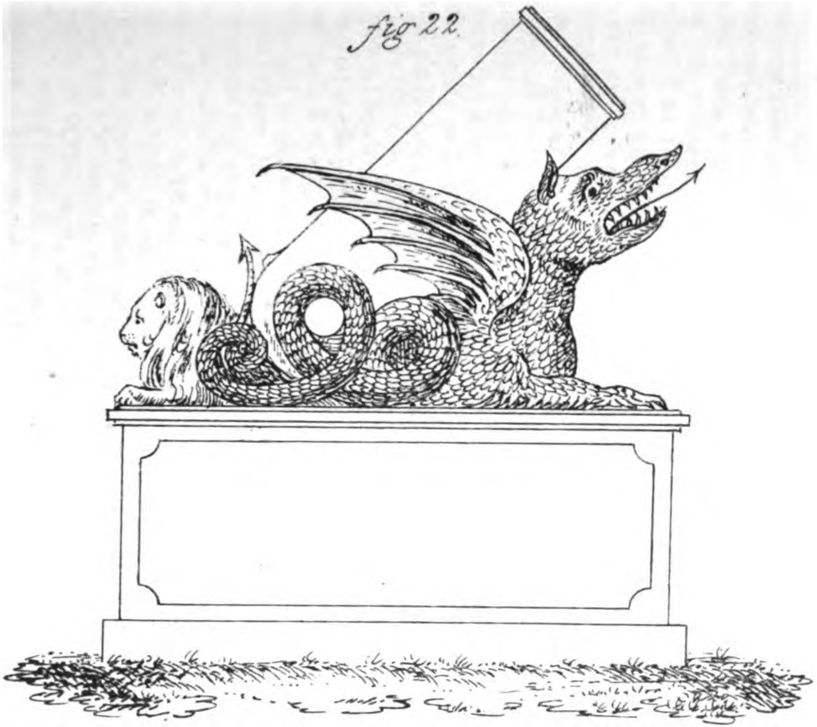
	ft	in	ths		ft	in	ths
Length of Mortar	4	11	0	Diam. of Breech & Muzzle	3	3	5
" Bore	2	3	0	" Bore	2	0	5
" Chamber	1	7	0	" Chamber		9	0

Weight of Mortar — 14,700 lbs

" Shell empty — 416 "

" " filled — 1,016 "

fig 22.



Cadiz Mortar.

of thickness in the shell, particularly of the culot, or part coming in contact with the charge, which from the great diameter of the cavity, had not a sufficient thickness to resist the shock of the powder, and concussion of the air. Fresh shells were ordered to be cast in the proportion shewn in fig. 21. The first 8 or 10 experiments were made with the dead shell filled with its proper weight in sand, and fired with various charges, from 6 to 12 pounds, gradually increasing. No accident occurred. The Artillery Officers being satisfied with these trials, the shell was loaded to a 3d and so on to its full charge, upwards of 1 barrel. One shell alone burst out of 6 at the mouth of the piece, the remainder fell near the target, and exploded with a fierce detonation, tearing up many cubic feet of earth, and scattering splinters to the distance of 450 yards. The shells were hoisted to a level, with the mouth of the cylinder, by means of a crane, supporting a swivel bar, on the one end of which were suspended 2 chains with hooks, to catch the rings of the shells, and on the other a weight nearly equalling that of the projectile, it was easily raised by these means, and then lowered without any jar into the chamber. A straw twisted wad was employed as a bottom. The operation of loading, required an average of 37 minutes to 50. The vent was fitted with a spring detonator, and the man who fired stood behind a traverse, and pulled the spring with a long cord. Eight horses were required to draw the carriage on which it was placed, and eight others to draw the carriage containing the bed. The weight of the empty shells being nearly 1000lbs., it is easy to calculate the number of these projectiles that could be moved in an ordinary ammunition waggon. The weight of the bed which is of timber is 16,000lbs., which together with the mortar make about 30,000lbs. add to this 100 shells for 100 rounds at 1000lbs. each, and 110 barrels of powder at 90lbs. each, and it gives the enormous dead weight of 70 tons, exclusive of gins, triangle, crane, carriage, and sundries. The name of Monster Mortar seems to have been well selected, for it is scarcely possible to conceive a more ugly, or unwieldy implement. With the exception of the mortar at Moscow, which has 36 inches in diameter at the mouth of the cylinder, and was, if ever used, employed for projecting masses of granite, the Monster Mortar exceeds any other weapon of the kind hitherto known. The original conception is due to Colonel Paixhans, it was executed under the direction of Baron Evain, and cast at the Belgian Royal Foundery at Liege.

31. The mortar burst at the camp on the heath at Braeschaet. It had been three times charged; first with 21, then 17, and afterwards with 15 kilogrammes of powder, and it was ascertained that it carried the shell to the same distance and with the same force, with the smaller as with the greater quantity. On being fired the fourth time, it was charged with only 9 kilogrammes of powder; but probably being too closely rammed, it split in two, throwing a piece of iron weighing 3000 kilogrammes, or nearly 6107 English pounds to a distance of about 20 feet.

32. It is remarkable that Colonel Paixhan's guns were not used at Antwerp, as the attack appears to have been carried on for display and to have been spun out, particularly in the attack of the Lunette, as a siege de Polygone.

Steam Artillery.

33. In a memoir on the comparison of the mechanical effects of gunpowder and steam, as applied to artillery, a German author Herr Precht concludes from a series of analytical deductions from facts and experiments, that steam artillery will never offer practical advantages over powder ordnance, and that it is an invention to be ranked among the number of discoveries, more curious than useful or applicable.

34. Steam can never supersede gunpowder as a projectile agent, every individual soldier, every light gun of a horse artillery battery, capable of acting with cavalry, has a supply of more than one hundred rounds of cartridge, which can instantly and without the aid of machinery, be turned into a most destructive power. As a general agent for warfare, it must ever remain inferior to gunpowder.

35. Two experiments were made on steam guns at Vincennes in 1828 and 1829. The first was not very satisfactory, and the second had no better results.

36. The enormous machinery was placed at 40 paces from a target representing the hull of a ship. The projectiles thrown were 4-lb. shot, they stuck in the wood. A 4-pounder gun was placed at the same distance, and the shot went through the hull.

PRACTICAL USE OF ARTILLERY.

The guns and projectiles are received from Europe or Bengal: the gunpowder is manufactured at Madras, where also the Ordnance carriages and beds are constructed.

In the course of annual practice usually carried on at Artillery Head Quarters, the object in view is, to accustom Officers and men to the use of Artillery, and teach them the various ways in which projectiles are thrown, their effects, and their ranges.

The Ordnance, Ammunition, and ranges are fixed by superior authority, but Officers in Command of batteries, and frequently Officers in charge of guns, are directed to regulate the charges, length of fuze, and elevation requisite.

Previous to commencing practice, the necessary batteries are erected, and a range marked off: this is generally done by the Public Department, and a small park is formed under the care of an Ordnance Officer, who must pay much attention to its neatness and order.

Officers receiving Ordnance and Stores for practice or service, should see that the equipments are not only correct in number, but also that they are well adapted to the nature of the ordnance. Spunges, shot and shells, should be most carefully examined, and in addition to the instruments for ascertaining their dimensions, they should undergo actual gauge with the ordnance they are intended for.

The usual confined limits of Practice grounds, does not admit of much variety in the use of ordnance, without endangering the lives of the inhabitants of the surrounding country; and therefore seldom can more be effected than direct firing from fixed batteries, and the emulation to be excited in young Officers, is confined within the narrow limits of throwing projectiles in a true direction, and hitting the object fired at: but the means are seldom at hand to enable them to judge of the momentum, penetration, and true effect of their shot or shells. A few examples under these heads will therefore be given, either in describing the use of the respective pieces of ordnance, or the projectiles thrown from them.

No young Officer should remain satisfied with what may be done at a morning's practice, he should make himself perfect master of all that he uses and sees in a battery—carefully note all instances wherein his expectations in firing are disappointed, and on every occasion use his best endeavours to account for discrepancies whenever they occur, and when in want of information never be above asking those, who may be able from their seniority or situation, to give it them.

Of all troops, Artillery is one, whose elementary tactics are the most complicated: an Artilleryman therefore requires much time, care and study, to become well acquainted with them in all their parts.

To disseminate the knowledge of the theory and practice of gunnery, in a full and regular course, would be difficult, and is perhaps unnecessary here, but a general notice of the established principles of the Service is indispensable.

The construction of the gun and the regulation of its equipment, depend not on the Officers called to use it. This is determined and arranged by the proper authorities, in the various departments of the Ordnance; tables of ranges formed from media of many sets of experiments are sufficient to guide Artillerists on all ordinary occasions, but in the infinite variety of circumstances under which they are called to act, a knowledge of the theory of gunnery, cannot fail to be of use on service, under special circumstances, not to be found in any practical memoranda that may have been collected.

The discoveries made by Robins, Hutton and others with the celebrated ballistic experiments, are little known to purely practical men, indeed they are only known to those, whose scientific qualifications enable them to glean the principles from a great mass of very abstract matter.

The determination by theory of the precise path or curve, described by a projectile in air, is a problem so difficult, that it could not even if solved, be of use to practical Artillerists, on account of the intricacies of calculation, which are quite inapplicable to actual service. But although our practice, under ordinary circumstances, may be conducted with tolerable certainty, according to the tables of ranges that have been published; no Officer should be ignorant of the principles, upon which these tabular cases are founded, nor of the important discoveries in gunnery, which relate to construction and effect.

In adopting the practice noted in their memoranda therefore, it cannot but be important, that Officers should have some idea of the velocities and effects due to the charges they use—the principles upon which these charges have been regulated and the effects of varying them, Officers should know the laws of the action of powder, in guns of different length, and in charges of different quantities; also the effects of shot of different weights or densities, of single balls and of plurality of shot. Officers should not be ignorant of the laws of the penetration of shot of different sizes, fired with different charges; nor of the effect of the air's resistance, on projectiles discharged with different velocities and varying according to the degree of celerity, and magnitude of the body.

The investigations respecting the effects of resistance, have been of vast importance in correcting that erroneous theory which disregards the resistance of the air, but which hypothesis, is still considered by persons ignorant of the true theory of gunnery, as regulating our practice.

The parabolic theory of gunnery, which proceeds upon the supposition, that the air does not resist the flight of the body, and consequently that the projectile motion in the direction of the tangent would be uniform, having been found, not to hold true in practice, and that the greater the projectile, the greater is the departure from the theory above stated. The celebrated Mr. Robins instituted some very ingenious experiments with his *Ballistic Pendulum* to determine the initial velocities of shot (that is the velocity with which they issue from the piece) by which together with the laws of resistance, everything relative to gunnery might be determined, but having only used Musket barrels it remained a great desideratum to repeat experiments upon the same principle, and on a much larger scale, than the means of a private individual could afford. The prosecution of this important investigation, was put into the able hands of Dr. Hutton, to whom the country is so much indebted for the high state of theoretical knowledge which the British Artillery possess. With the aid of the ballistic pendulum, it was found that the velocities assigned to projectiles, according to the parabolic thoery, are much less than the actual velocities, and that the resistance of the air, instead of being inconsiderable, is such, that projectiles which, with, an initial velocity of 2000 feet in a second, range only between 2 and 3 miles, would in vacuo, range 20 time as far.

This difference is shewn in the following table, by which it appears that the ranges, instead of being as the squares of velocities, as in the parabolic hypothesis, are in a less proportion than the velocities, and from 800 to 1600, the most ordinary velocities with guns, the ranges are nearly as the square roots of the velocities.

Table of the Motions of a 24-pound Shot, projected at 45° Elevation.

TABLE I.

Velocity per second.	Range in vacuo or according to parabolic theory.	Actual range.
feet.	yards.	yards.
200	415	320
400	1658	1000
600	3731	1391
800	6632	1687
1000	10362	1840
1200	14922	1934
1400	20310	2078
1600	26528	2206
1800	33574	2326
2000	41450	2438
2200	50155	2542
2400	59638	2640
2600	70050	2734
2800	81241	2827
3000	9 3262	2915
3200	106111	2995

In practice it also appears that the greatest range is not produced by an elevation of 45°, but that according to the weight and velocity of the projectile, the amplitude may be increased, by lessening the elevation, even as low as 30°, small velocities and large shells ranging furthest at an elevation of nearly 45° whilst about 30° produces the greatest range with small shells projected with great velocities. In the first case the resistance is comparatively trifling—in the latter it is such as is exhibited in the table.

To explain the nature of resistance to the flight of shot and shells, it must be remarked that in the motion of a ball through the air, no particle of that fluid can be disturbed, without at the same time a great many others, and not in any one direction, but according to that of their contact, with those from which the impulse is received. As the moving body passes on, there is left behind it a kind of vacuum more or less complete according to the degree of velocity. When the ball moves quicker than the air can rush into the space left behind, the vacuum becomes complete. Now there is a certain limit to the velocity, with which air can rush into a vacuum, viz. about 13 or 1400 feet in a second, and consequently when the velocity of the ball is greater than this, it is manifest that the resistance, must be much increased, for there being no pressure of the fluid behind the ball, it will have to support the whole weight of a column of the air, on its fore part, as well as to give motion to the particles which it strikes, and the air which is before it will be in a very condensed state.

The effect of resistance is so various, according to the velocity, diameter, and weight of the projectile, that experiment alone can determine it.

From Dr. Hutton's account of his experiments, the following deductions were made.

1st. That Powder appeared to flame almost instantaneously. This appeared to be the case with the ordinary charges of powder; but when great charges were used, the velocity of the ball became less, with any augmentation of the charge beyond a certain quantity. The ball being driven out before all the powder has ignited, the inflammation though apparently instantaneous, is nevertheless only rapidly progressive.

2d. Balls of the same weight were fired with different charges of powder from the same gun—the result shewed that the velocities communicated were directly as the square root of the charges of powder.

3d. The velocities communicated by constant charges,

" to shot of the same diameter, but of different weights are inversely, as the square root of the weights.

To gain an increase of range or penetration, or to augment the force of the blow, with which shot strike, balls made of heavier matter, may be used with advantage. A shell filled with lead will produce a greater blow than an Iron shot of the same diameter, discharged with the same quantity of powder, it may also be made to range further, from being better able to overcome the resistance of the air ; and consequently retaining longer the superior velocity communicated by a greater charge of powder. From this a degree of accuracy also results, because the same range may be produced with less elevation, and accuracy is gained as elevation is reduced.

The weight of a 24 pdr. shell run full of lead of the same diameter as the shot is about 27·975lbs., for the weight of the shell is 16·48lbs. and that of a solid ball of lead of the diameter of the cavity (3.767) inches is about 11·49 lbs. now the velocities of balls of the same diameter, but of different weights, discharged with the same quantities of powder, being inversely as square root of the weight of the balls, the velocity of the shell shot will be less than the velocity of the iron ball in the proportion of 28 to 24, so that the velocity of a 24-pdr. iron ball, with a charge of 8 pounds, being 1339 feet per second, the velocity of the shell shot of 28lbs. weight with the same charge would be 1224 feet. But the velocities of balls of the same weight, being directly as the square root of the charges, if we increase the charge from 8lbs. in this proportion, viz. 9·094lbs. or 1-10th nearly, the velocity of the shell shot will be equal to that of 24lbs. ball.

This is a very simple way of increasing the weight of metal and on particular occasions, it may be used with considerable advantage.

At the siege of Cadiz, the French used shells filled with lead, which discharged with a velocity of 2000 feet in a second from Howitzers, ranged to the astonishing distance of 3 miles.

4th. A very great difference in the velocities of balls, arises from very small differences in the windage, and that as balls are often less than the regulated size it frequently happens, that half the force of powder is lost by unnecessary windage.

The prejudicial effect which, too much windage has upon accuracy, arises from the reflections of the ball in passing out of the bore.

These will manifestly be greater in proportion as the difference between the diameter of the shot and calibre of the gun increases. From these reflections, shot acquire a zigzag motion, and do not generally quit the cylinder in the direction of its axis.

If the last bound be upon the lower part of the bore, the angle of the shots departure will be increased, if above diminished, these affect the length of range. If the last reflection be on either side of the bore, the line will be altered, and in every case, the friction arising from these rubs, will give the ball an irregular whirling motion, productive of great irregularity of resistance from the air, unless the rotation be at right angles to the direction of the projectiles flight.

5th. With equal charges and guns of equal weight, but of different lengths, the velocity of the shot increases with the length of the gun, but in a small proportion only.

6th. The velocity of the ball, increases with the charge, to a certain point peculiar to each gun, and that by further increasing the charge, the velocity of the projectile, gradually diminishes, till the bore is quite full of powder, yet the recoil is always increased by an increase of powder, because the ball escapes before the powder is all inflamed, which therefore acts latterly on the gun only.

7th. The velocities of balls fired with equal charges increase, as the gun is longer in proportion, which is nearly the middle ratio, between the square and cube roots of the length of the bore.

8th. Varying the weight of the gun produced no change in the velocity of the ball, additional weights were attached to pieces, so as to restrain the recoil, but although the arcs of the recoil were thus shortened, yet the velocity of the ball was not altered by it ; the recoil was then entirely prevented, but the initial velocity of the gun remained the same.

9th. The results of different experiments to ascertain the penetration of balls were various, arising no doubt from inequality in the consistency of the blocks of wood, and from different degrees of elasticity, but they yeild with certainty the following conclusions.

1st. That if equal balls be discharged against a mass of timber, the depth of the cavities, will be nearly as the squares of the velocities.

2d. That unequal balls of the same matter, discharged with the same velocity, will penetrate to depths according to their diameters, so that a greater ball will not only make a larger hole, but will also penetrate further, than a small ball discharged with the same velocity.

An 18-pounder with a charge of 1 pound of powder, was fired at a butt formed of oak planks 6½ inches thick, crossed upon each other, forming consequently a mass 13 inches thick. At 30 yards the shot always passed through, driving the splinters from 10 to 30 yards distance. Another butt was formed of 5 thicknesses of plank, instead of 2, consequently 32½ inches thick. The planks were placed perpendicularly and horizontally, alternately, each plank tree-nailed to the next behind it, and the whole mass well bound together. An 18-pounder, discharged successively with 3½, 3 and 2½lbs. of powder, perforated the butt each time, driving great quantities of splinters before it, but the lowest charge, viz. 2½lbs. occasioned the greatest ravages, for it drew the tree-nails—separated the planks from each other, and broke the inside plank short in two.

A third butt was then made of beams of well seasoned English oak, about a foot and a half thick and two feet broad, three of these were set perpendicularly into the ground, close to each other, then 3 laid on each other horizontally and three more set perpendicularly behind. The whole were then firmly bolted together by iron bolts, 1½ inch in diameter, forming a solid mass 4½ feet thick.

An 18 pdr. being fired with 6 pounds of powder, the balls in several rounds, penetrated into the mass, from 37 to 46 inches.

With 3 lbs. the penetration was about 30 inches.
With 2½ lbs. the penetration was about 28 inches.
With 1 lb. the shot penetrated from 14½ to 15½ inches.

A 6½ feet 24-pdr. double shotted with 4 lbs. of powder, at a butt of timber, 5 feet 2 inches thick, placed 100 yards from the gun, most of the shot perforated the butt, and ruined two gun carriages placed behind it. An 18 lb. shot, fired with a charge of 4 lbs. perforated 34 inches into dry elm—whence it appears that elm timber resists less than oak, in the ratio of about 17 to 19.

10th. Different degrees of ramming, or different dimensions of wads, made no sensible alteration in the velocities of the balls. Stout firm junk wads, so tight as to be with difficulty rammed into the gun were used, sometimes they were placed between the powder and ball, sometimes over both, but no effect was discovered in the velocity of the ball.

Different degrees of ramming were also tried without wads—the charge was sometimes set home without being compressed, sometimes rammed with a different number of strokes, or pushed with various degrees of force; but the velocity of the ball remained the same. Wads do not prevent the escape of the inflamed powder by the windage, nor under any circumstances, occasion any sensible difference in the velocity of the ball.

11th. There is very little advantage gained by any increase in the length of guns, beyond a certain limit, since the superior initial velocity of shot from long guns, is reduced to an equality with those from short guns, after passing over certain spaces.

12th. There is no advantage in increasing the charge, beyond what is necessary to produce a certain velocity, since the increased resistance, soon reduces it to an ordinary celerity.

13th. It was proved that the velocities are nearly in the proportion of the square root of the charges.

14th. There is a gradual and regular increase of resistance, as the velocity is increased, as far as a velocity 1400 feet per second, when the vacuum behind the ball being complete, resistance is greatest, and is then as $2\frac{1}{9}$ power of the velocity nearly, after which the resistance gradually decreases, as the velocity increases, till it arrives at about $2\frac{1}{10}$ power; a law unknown until it was discovered by these experiments.

All that can be done until a perfect knowledge of the nature and law of resistance be obtained, is to collect together some of the best practical rules, founded partly on theory, and partly on practice to guide us in improvement, or at least to prevent us falling into error.

To determine the initial velocity of a Ball.

The velocities of different balls, with different charges of powder, are as the square roots of the weights of powder directly, and inversely as the square roots of the weight of balls.

TABLE II.

Balls.			Powder.	Elevation of gun.	Velocity of ball.	Range.	Time of flight.
Weight.		Diam.					
oz.	dwt.	inches.	ounces.	deg.	feet.	feet.	seconds.
16	5	1·96	2	15	860	4100	9
16	8	1·96	4	15	1230	5100	12
16	12	1·96	8	15	1640	6000	14½
16	12	1·95	12	15	1680	6700	15½
16	10	1·96	2	45	860	5100	21

To determine the initial velocity of a 24 pound ball, discharged with 8 lbs. of powder. By the table it appears that 8oz. of powder discharged a 1lb. ball with a velocity of 1640 feet. Then as $\sqrt{\frac{8}{1}}$oz. : $\frac{128}{24}$ :: 1640 : $1640\sqrt{\frac{16}{24}} = 1640\sqrt{\frac{2}{3}} = 1339$, the velocity of the 24 pdr. ball.

To determine the resistance of the air to a ball, discharged with any velocity.

Resistances to a ball of 1·965 inches diameter, and 16oz. 13 dwts. weight.

TABLE III.

Velocity.	Resistance.	Velocity.	Resistance.
100 feet	·17 lbs.	1100 feet	28·56 lbs.
200 ,,	·71 ,,	1200 ,,	35·28 ,,
300 ,,	1·61 ,,	1300 ,,	42·71 ,,
400 ,,	2·91 ,,	1400 ,,	50·72 ,,
500 ,,	4·65 ,,	1500 ,,	59·19 ,,
600 ,,	6·90 ,,	1600 ,,	63·93 ,,
700 ,,	9·75 ,,	1700 ,,	76·78 ,,
200 ,,	13·25 ,,	1800 ,,	85·54 ,,
900 ,,	17·52 ,,	1900 ,,	94·11 ,,
1000 ,,	22.63 ,,	2000 ,,	102,36 ,,

Thus to determine the resistance of the air against a 24 pound ball, discharged with a velocity of 2000 feet in a second. By the table it appears, that the ball of 1.965 inches diameter with a velocity of 2000 feet, suffered a resistance of 102·36lbs. The resistances, to equal velocities being as the surfaces of the balls, *i. e.* the squares of their diameters, we have as 3·86 (square of 1·965) : 31·36 (square of 5·6 diameter of 24 lb. ball) : : 102·36 : 829 lbs. the resistance to a 24lb. ball with a velocity of 2000 feet in a second.

But in computing these resistances the decrease in the density of the air upwards has been disregarded, whereas projectiles are less and less resisted as they ascend, and consequently rise to greater heights than if the medium were of uniform density. To determine the difference, resulting from this it is necessary to know the greatest velocity any ball can acquire in descending through the air, that is the terminal velocity, with which the ball will uniformly descend, when the resistance becomes equal to the urging force, that is, equal to the weight of the ball.

Dr. Hutton formed the following Table, in which the terminal velocities corresponding to all natures of balls are given, and the heights from which they must descend in vacuo to acquire such celerities.

TABLE IV.

Weight of ball.	Diameter of of ball.	Terminal velocity.	Height due to terminal velocity.
pounds.	inches.	feet.	feet.
1	1.923	247	948
2	2.423	277	1193
3	2.773	297	1371
4	3.053	311	1503
6	3.494	333	1724
9	4.000	356	1970
12	4.403	374	2174
18	5.040	400	2488
24	5.546	419	2729
32	6.106	440	3010
36	6.350	449	3134
41	6.684	461	3304

When the initial velocity is known, the elevation which produces the greatest range, and that range, may be found by the following table of Dr. Hutton's.

To use this table, divide the initial velocity, by the terminal velocity, and with the quotient enter the first column in the table. The corresponding elevation will be found in the second column and the number opposite in the third column multiplied by the altitude due to the terminal velocity will give the range nearly.

Table of Elevation giving the greatest range.

TABLE V.

Initial velocity divided by the terminal velocity.	Elevation.		Range divided by altitude due terminal velocity.
	°	″	
0.6910	44	0	0.4110
0.9445	43	15	0.6148
1.1980	42	30	0.8176
1.4515	41	45	1.0210
1.7050	41	0	1.2244
1.9585	40	15	1.4278
2.2120	39	30	1.6312
2.4655	38	45	1.8346
2.7190	38	0	2.0379
2.9725	37	15	2.2413
3.2260	36	30	2.4447
3.4795	35	45	2.6481
3.7330	35	0	2.8515
3.9865	34	15	3.0549
4.2400	33	30	3.2583
4.4935	32	45	3.4616
4.7470	32	0	3.6650
5.0000	31	15	3.8684

To find the greatest range of a 24-lb. ball, discharged with a velocity of 1640 feet in a second, and the corresponding angle of elevation to produce that range. The terminal velocity of a 24-lb. ball (Table No. 4) is 419, and its corresponding altitude 2729. Then $\frac{1640}{419}=3.91$, nearly, equal to a mean between 3.733 and 3.9565 in the first column of Table

No. 5, to which corresponds the mean elevation 34° 37', then the number 3.4532, a mean between 3.0549 and 2.8515 in the third column, multiplied by 2729, the height due to the terminal velocity, Table No. 4, gives 9424 feet, or upwards of a mile and three-quarters, for the greatest range.

In like manner, to find the greatest range of a 9-lb. ball, with an initial velocity of 1500 feet in a second.

$\frac{1500}{356}=4.21$ which is nearly equal to 4.24 in the first column of Table 5. The corresponding elevation is 33 30 and the number 3.2583 in the 3d column, multiplied by 1970, height due to the terminal velocity 356, gives 6418 feet, or 2039 yards nearly.

These examples are only adapted to the range of Cannon balls. The greatest ranges of guns are very considerable; but it is not usual to discharge cannon shot at great elevations, on account of the uncertainty of such practice.

Dr. Hutton gives the following table of the terminal velocities of, and heights due to all natures of shells.

Table of Dimensions, Weight, Terminal Velocities, and Altitude due to Terminal Velocities of Shells.

TABLE No. VI.

Diameter of mortar.	Diameter of shells.	Weight of shells filled.	Weight of equal solid.	Ratio of shell to solid.	Terminal velocity.	Altitude due to terminal velocity.
ins.	ins.	lbs.	lbs.		feet	feet.
4.6	4.53	9	12¾	1.42	318	1580
5.8	5.72	18	25⅓	1.42	356	1980
8	7.90	47	67	1.42	420	2756
10	9.84	91⅓	130	1.42	468	3422
13	12.80	201	286	1.42	534	4430

Column 3 shews the weight of the shell filled with powder, column 4 that of solid iron balls of the same size, and the ratio of these weights is given in the 5th column. Shells being lighter than equal solid iron balls, in the ratio of 1 to 1.42 have in that proportion, less power to oppose resistance, and the greatest or terminal velocity, as given in the 6th column, will be less in proportion.

The seventh column shews the heights due to these velocities in vacuo. From this Table and Table No. 4, the greatest range and corresponding angle of elevation of mortars may be determined.

Thus to find the greatest range and corresponding angle of elevation, for a 13-inch shell, discharged with a velocity of 2000 feet in a second; 2000 the initial velocity, divided by 534, the terminal velocity, taken from Table No. 6, gives 3.74, opposite to which in Table 5, the elevation 35° will be found to correspond. Then the number 2.8515 (corresponding in proportion) obtained from 3d column of No. 5, multiplied by 4430, the altitude due to the terminal velocity of the shell, (column 7, Table 6) gives 12632 feet (about 2⅓ miles) for the greatest range.

Thus it appears, that even with the largest shells, particularly when the charges are great, there is a very considerable deviation from the parabolic theory, according to which 45° should give the greatest range.

The elevation required to give the greatest range of a 13-inch shell, discharged with a velocity of 1500 feet per second is 37° 37'; with a 10-inch mortar, the elevation corresponding to the greatest range of a shell projected with the above velocity is about 36½°.

From this it follows, that instead of fixing all mortars in their beds at 45° of elevation, the angle should be that which, with the full charge, gives the greatest range.

The various ways in which projectiles are thrown, may be enumerated as follows:—

1st Direct fire.
2d Oblique do.
3d Reverse do.
4th Enfilading or raking fire.
5th Ricochêt fire.
6th Vertical do.

Direct fire, is when the battery of guns is drawn up parallel to the line of Troops or works to be fired at, so that the shot strike the object perpendicularly to its fall.

Oblique fire, is when the shot from the gun strike the object at an angle or obliquely.

Reverse fire, is from a battery in the rear of a line of Troops or works, the shot taking it in reverse.

Enfilading fire, is when the battery is ranged at right angles or nearly so, to a line of Troops or Works, the shot from the guns raking or sweeping the line in its own length. The guns being fired with their full charge of powder.

Ricochêt Fire, is when the guns placed as in an enfilading battery are fired with a diminished charge and slight elevation; under these circumstances, the shot is deprived of its greatest velocity, and describes a curve in its flight, hence it is easy to conceive, that on striking the ground, it will bound again with shorter hops, than if it had a greater velocity. Both shot and shell can thus be made to graze over the crest of a parapet, and not along the work; although the force will not be so great as with shot fired with the usual charge, it will be sufficiently so, as to disable guns, carriages, and men, which is all that is required: and shells (from howitzers and long guns) bursting in this manner will have their full effect.

Vertical Fire, is that from mortars, it is so called to distinguish it from the more direct fire of large guns, which is called horizontal fire.

In attacking a fortress, the assailants artillery has two objects to gain, viz. silencing of the defensive batteries, and the beating down of the defensive masses and revetment; to effect the first, he has to establish the enfilading and ricochêt batteries (both at a distance and on the crest of the glacis) to oppose directly the defender's guns: these are called *Counter Batteries.* To beat down the revetment, and make an opening or breach fit to assault, for which purpose batteries are erected on the crest of the glacis, and called *Breaching Batteries.*

These various modes of projecting metallic globes (some solid and some contrived to burst at pleasure) have rendered powerful batteries of artillery capable of sweeping and annihilating all before them, and have reduced the science of fortification nearly to a state of calculation, as to the amount of defence any place is capable, and the power necessary to reduce it.

The following list of Ordnance and Stores is given, to shew what is generally requisite.

The numbers of Ordnance, and quantity of stores must depend on the plan of practice, or the nature of the service.

Officers should be very careful of the ammunition and stores entrusted to them, and although artillery should never be crippled in their means, it ought to be a sacred principle never to waste, and a pride to effect the utmost with the smallest means.

ORDNANCE AND CARRIAGES.

Iron Gun with Carriage and Limber	18	Pounder.
,, ,, ,,	12	,,
Mortars with beds	10	Inch.
,, ,,	8	,,
,, ,,	5½	,,
Howitzer brass with Carriages	24	Pounder
,, ,, ,,	12	,,
Guns brass ,, ,,	9	,,
Carts ammunition.		
,, mortar.		
,, platform.		

AMMUNITION AND MILITARY STORES.

Axes felling with helves.
,, hand.
,, pick.
Augers, fuze.
Bags, gunny for shot.
Balls, leaden for musket.
,, fire.
Bamboos, common.
Banner rolls.
Barrels, budge.
Barrows, wheel.
Baskets, rattan or wicker.
Bellows, hand for proving shells.
,, forge, large

Benches, fuze.
Bill hooks.
Bitts, gun steel, heavy field.
„ „ light „
Boxes, copper dredging.
Brooms, bundles.
Brushes, painting hair.
Buckets, gun wooden.
„ tar.
Boxes, for quick match.
Canthooks, pairs.
Canvass, bolts.
Cartridges, cloth empty.
„ serge.
„ cloth starting.
Chalk, lbs.
Charcoal, bushels.
Carcasses.
Carriers for hot shot.
Chain, measuring 100 feet.
Chatties.
Cloth white cubits.
„ waxed.
„ powder magazine.
Coins, gun and mortar.
Compasses, brass calibre.
„ „ common.
„ „ iron calibre.
Crows, iron.
Curtains, 6 and 9 feet high with ropes and pegs.
Cylinders, tin loading.
Drivers, wooden for fuzes.
Emery, lbs.
Engines, fuze small.
do. large.
Flags, range large complete with staff, &c.
„ „ small with staves.
Flour, measures.
Forks, for hot shot.
Funnels, copper.
Fuzes, drove common.
„ „ S. C. S.
Gauges, shells sets.
„ shot.
Gins complete with fall and blocks.
Glasses, perspective.

Grease, gallons.
Grenades, hand.
Gunpowder, corned 90lbs.
„ mealed, lbs.
Hammers, claw.
Handspikes. purchasing.
Haversacks, leather.
Jacks, hand large.
„ „ small.
Instruments, perpendicular.
„ quadrant.
„ S. C. S.
Knives, fuze.
„ Laboratory.
Ladles, copper with worms.
Lamp, black lbs.
Leathers, bearing.
Levels, plummet.
Lintstocks, with cocks.
Lanthorns, horn.
Line, log skeins.
Locks, pad, single.
Mallets for driving pickets.
Match, cotton skeins.
„ quick „
Measures, copper powder sets.
Mamoties, with helves.
Nails, iron lbs.
Needles sail.
„ sewing.
Nets for wads.
Oakum, lbs.
Oil, cocoanut gallons.
„ linseed „
Paint, black lbs.
Palms, hand steel.
Pickets, platform.
„ park.
„ range.
Pincers, common.
Platforms, mortar.
Plummet lines complete.
Portfires, drove.
„ stocks.

Pots, water.
Pouches, priming.
Prickers, gun.
Rammers, earth.
Rasps, fuze.
Reels, camp.
Rods, measuring 3 feet.
„ „ 5 „
„ „ 10 „
Ropes, drag sets.
Rope, coir coils.
Saws, fuze.
Scales, Gunter.
Scales and weights large sets.
„ „ small „
Searchers with staves and relief.
„ one pronged.
Scissors, pairs.
Setters, wood fuze.
Shells, iron empty.
Shot, round loose.
„ canister.
„ S. C. S.
Skins of sheep for covering mortars.
Spunges gun, common and concave.
„ howitzer and mortar.
Spunyarn, rolls.
Stands for scales and weights.
Slings, guns.
Tar, gallons.
Targets, gun canvass with frames 12 feet square.
Tarpaulins, magazine large.
„ „ small.
Thread, cotton, lbs.
Tools, cooper's brass adze.
„ „ driver.
„ „ vice.
Triangles or stands for plummets.
„ for scales and weights.
Twine, country skeins.
Vices, bench.
Wads.
Wax, bees, lbs.

On service the heavy ordnance do not always follow an Army in all its movements, but still they are generally so placed, that they may be brought up in a short time whenever required. The park should contain spare carriages, stores and ammunition for every description of ordnance to to be employed, and a moveable magazine in carts or waggons.

MORTARS.

Mortars are used to throw Shells filled with powder and combustibles, which falling on buildings, or into stockades are made to burst, and with their fragments destroy every thing near them. They search behind and knock down the defensive traverses, drive a Garrison out of its entrenchments, and carry destruction and disorder through every portion of the interior of defensive expedients; they tease and harass the guards and sentries, burn the Barracks, Store houses and Depôt of Provisions, explode expense and other Magazines.

Shells from Mortars are seldom thrown at Troops, but when expedient they should be so managed as to burst just over their heads.

When thrown on buildings they should be made to burst on coming in contact with the object, and in addition to the powder, pieces of portfires, ends of fuzes, and other combustibles should be put in them whenever it is wished to cause conflagration.

When thrown into a Stockade shells should be made to burst before touching the ground, as, if the latter is wet and swampy, the shells will bury themselves. This happened during the last Burmese war and also at Antwerp, where the Dutch made excellent practice on the French trenches, but the ground being swampy, the effects of the shells were lost.

Great precautions are necessary in firing Live Shells and particularly so when the range is short, as on a Shell's descending and bursting in the air, the pieces fly in all directions, sometimes as far back as 300 and 400 yards.

To bombard a place in a manner really efficient a number of Mortars should be put in battery. They should fire without intermission throughout the day and night, and with that view be furnished with at least 200 rounds per day. Any increased number of Mortars used at a bombardment would not necessarily increase the expenditure of ammunition, as a certain number of rounds fired in three days from 20 Mortars is infinitely more likely to terrify the inmates of an enclosure, than the same number of rounds fired in six days from 10 pieces.

Experience shews that to be effective, bombardment must be destructively incessant. Large mortars such as 13 and

10 inch are too unwieldy to be generally used in India where made roads are seldom to be found ; an eight inch shell has momentum sufficient to penetrate through the roofs of Indian buildings, and in the field the Royal and Cohorn Mortars are quite sufficient for Stockades or other temporary enclosures.

In using large Mortars, firing with a fixed elevation is incomparably easier than using a fixed charge, but with small Mortars which in consequence of their lightness and portability, are so frequently, indeed it may be said, constantly called for in hilly, jungly, or stockaded countries, such as the Burmese territories, fixed charges might be used, altering the elevation with reference to distance.

Small Mortars were recommended by Major General Wellesley for the defence and settlement of Wynaad. They were much used in Malacca and Goomsur, and even at the late siege of Antwerp, they were found of the greatest service by both parties, for they did much execution and were extremely difficult to dismount.

In 1832, during the operations in the Malayan Peninsula, Captain Bond who commanded the Artillery, stated, in his report to Artillery Head Quarters : " It frequently happens " that the advance of the clearing party unexpectedly un- " covered Stockades, from which heavy vollies were poured " on our men, who seldom could advance without being " exposed to fire on their flanks from other Stockades " erected for this purpose. Our ordnance were at first con- " siderably delayed opening their fire in consequence of our " common mode of firing Mortars at a fixed elevation, and " varying the charge according to the range : instead of " this method I latterly directed a fixed charge for the 5½ " inch mortar and the elevation to be varied according to " the range, and after a little practice our fire was much " more rapid, and the charge nearly filling the chamber, " shells were thrown with much more precision than by a " small charge, and the elevation being less than 45° and " sometimes as low as 22° the effect was likely to be more " destructive."

Lieutenant Congreve one of the officers employed in Goomsur states " that all the officers of Artillery present in " the Goomsur campaigns were in the constant habit of " measuring out charges for their Mortars and Howitzers

" and making them up into Cartridges before taking the Field, " and to prevent confusion in the selection of them, each " bag had marked on it the range in yards, answering to " the charge in numbers it contained ; Fuzes were also ready " cut, and so packed that the jolting of the boxes " should not damage the exposed portion of composition. " This system saved a great deal of unnecessary trouble " and delay and had it been practised from the commencement " of hostilities, many valuable lives would have been " spared ; for had we been enabled to bring the Mortars " into action immediately on arrival at the scene of operations, " and caused the shells to burst in rear of, or amongst " the Wolsas, the enemy would as subsequently proved to " be the case, on the first Shell alighting in the midst of " them, have taken to flight, instead of throwing in a very " heavy and galling fire from their position in the thickly " wooded hills, impervious to musketry."

With small Mortars three or four fixed charges would be ample, and the Cartridge bags for this purpose might be made of different coloured serge, or where that could not be obtained, simply numbered 1, 2, 3, 4. No. 1 denoting the largest charge ; one charge only for all distances would cause a waste of ammunition and no more powder should be used than is necessary to carry the Shell to the intended distance.

The most splendid specimen of a Bombardment we have on record in India, was the siege of Hattrass ; a Fort situated about thirty-two miles N. E. of Agra, and which was bombarded by the Bengal Artillery with 42 Mortars, when upwards of 3000 Shells were fired. This bombardment evinced what can be effected by Artillery with sufficient means. The havoc and destruction caused was fully proportionate to the expenditure. Scarcely ten minutes elapsed after the commencement of the Bombardment, ere several fires were discovered in the Fort, the Batteries opened at 9 A. M. on a signal from the Rocket Battery, before 12 o'clock the Bungalow in the N. W. Bastion of the inner or upper Fort, was consumed, and the gateway towards the Kutterah blown in ; about 3 o'clock numberless fires were seen in the Fort and horses running loose on the ramparts. About 5 the Magazine exploded, an explosion too awful and terrific for description involving the whole Fort in smoke and ruin—the fire in all parts seemed to increase, and the increasing discharge of the Mortars carrying destruction into the place, was enough to appal the bravest heart. The bravery and resolution of the enemy were of no avail, and the lofty and massive walls ceased to be impregnable to a species of ordnance which involved the interior of the place in conflagration and ruin, from which there was no refuge. The Garrison sunk under the dreadful operation which exposed them to certain death, and sought safety in flight.

The Burmese Army in 1824 had no other protection against our Shells, (thepractice of which was excellent during the War) but pits covered over with planks, in which they hid themselves and these were found in almost all the Stockades which were taken.

MORTARS.

Table of Brass and Iron Mortars.

	Mortars.																	
	Weight of Mortar.			Weight of Bed.			Length.				Diameter.							
							Bore.		Chamber.		Bore.		Chamber.					
													Superior.		Inferior.			
	cwt.	qrs.	lbs.	cwt.	qrs.	lbs.	ins.	ths.	ins.	ths.	ins.	ths.	ins.	ths.	ins.	ths.		
Brass 13 inch	28	2	0	23	0	0	21	6	14	0	13	0	6	6.5	3	3		
do. 10 do.	12	0	0	16	1	5	16	8	9	5	10	0	5	0	2	8		
do. 8 do.	6	2	0	9	0	0	13	3	7	0	8	0	4	1	2	3		
do. 5½ do.	1	3	0	4	0	16	7	8	5	4	5	6.6	2	8	2	0		
do. 4⅖ do.	0	3	11	1	2	0	7	0	3	7	4	5.2	2	2	1	5		
Iron 13 do.	35	3	11	52	3	7	13	0	13	0	13	0	13	0	6	5		
do. 10 do.	16	1	11	17	1	21	10	0	10	0	10	0	10	0	5	0		
do. 8 do.	8	1	4	7	1	16	8	0	8	0	8	0	8	0	4	0		

Table of Powder allowed for various purposes with Mortars.

	Powder.											
	Chamber contains		Proof.				Bursting Shells.		Starting Fuzes.		Sealing.	
			of Mortar.		of Bed.							
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	oz.	drs.	oz.	drs.
13 Inch	9	0	9	0	6	0	6	12	4	0	4	0
10 do.	4	0	4	0	2	11	2	10	3	0	3	0
8 do.	2	4	2	4	1	8	1	14	2	8	2	8
5⅔ do.	0	10	0	10	0	6⅔	0	12	1	4	1	4
4⅖ do.	0	4½	0	4½	0	3	0	8	1	0	1	0

It has been ascertained by experiment that the effect of the charge is the same, whether in bags or not.

Charges should always be carefully weighed: the practice of giving out charges by measure, is incorrect, as in equal measures, the S.G. takes up more room than the L.G.

Table of Shells for Mortars.

	Diameter			Thickness of Metal.	Shell Diameter.		Windage.			Weight, empty.	
	of Bore.	Fuze hole			Maximum.	Minimum.	Maximum.	Medium.	Minium.		
		Exterior.	Interior.								
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	lbs.	oz.
13 inch	13·0	1·84	1·7	2·1	12·88	12·8	·12	·16	·2	200	0
10 do.	10·0	1·61	1·5	1·6	9·88	9.8	·12	·16	·2	88	0
8 do.	8·0	1·22	1·13	1·3	8·95	7·85	·05	·1	·15	41	3
5⅔ do.	5·66	0·9	0·84	0·85	5·62	5·57	·04	·065	·09	15	0
4⅖ do.	4·52	0·82	0·77	0 7	4·476	4.432	·044	·066	·088	7	8

The number of men for the service of Mortars in Batteries is as follows :—

13 inch	6 men.	5½ inch	3 men.
10 „	5 „	4⅖ „	3 „
8 „	4 „		

The following is their disposition and duties.

13-*inch Mortar.*

No. 1, Commands, serves the vent and points.

No. 2, Runs up, traverses, spunges, uncaps the Fuze, wipes the bottom of the Shell, and assists to put it in.

No. 3, Runs up, traverses, puts in the charge, assist to put in the Shell.

No. 4, Runs up, traverses, prepares and brings up Shells, assists to put them in, and primes.

No. 5, Runs up, traverses, prepares and brings up Shells, assists to put them in and fires.

No. 6, Brings the charge, cuts and fixes Fuzes.

10-*inch Mortar.*

No. 1, Commands, serves the vent and points.

No. 2, The same duties as with 13 in. Mortar.

No. 3, The same duties as with 13 in. Mortar, and brings the charge.

No. 4, Runs up, prepares and brings Shells, cuts and fixes fuzes, and primes.

No. 5, Runs up, prepares and brings Shells, cuts and fixes fuzes, and fires.

8-*inch Mortar.*

No. 1, Commands, runs up, serves the vent, points and primes.

No. 2, The same duties as above.

No. 3, Runs up, traverses, brings the charge and puts it in, puts in Shells.

No. 4, Runs up, prepares and brings Shells, &c. and fires.

5½ *and* 4⅖ *inch Mortars.*

No. 1, in addition to his duties detailed at an 8-inch

Mortar, prepares Shells, 3 brings them up and fires; the rest as with the 8-inch Mortar.

With 2 men 1 brings ammunition and loads and 2 fires, in addition to the other duties.

The Shells ought always to be deposited behind traverses, raised for the purpose, or in a sheltered spot, and one or two men according to circumstances, appointed to scrape and clean the inside of them, and prepare them for the powder and fuze; besides men to weigh or measure out the charge of powder, according to the directions received from No. 1.

Stores necessary.

Spunge
Loading Cylinder
Pair of Shell or cant hooks
Handspikes
Fuze Engine
Filling Funnel
Mallet or driver
Setter
Bellows Hand
Gunters scale
Portfire stick
Sheep skin
Rasp
Linstock
Pointing Rods
Plummet and Line
Quadrant
Perpendicular
Vice
Dredging box
Chalk
Bitt steel
Pricker
Knife
Saw
Scraper
Bearing Leathers
Compasses

At the Magazine.

1 Budge Barrel
1 Sett Weights and Scales
1 Sett Powder Measures.

Method of placing Mortars in Battery.

Mortars are generally placed in Battery 15 feet from each other, at such distances from the epaulment, as may be required by the elevation.

Mortars are generally fired at an angle of 45° this custom however does not appear to have any foundation in reason, on the contrary, when Shells are thrown upon Magazines or any other Buildings, the Mortar should be elevated as high as possible, that the Shells may acquire a greater force in the fall, and consequently do more execution.

Again when firing at Stockades or low works, the elevation must be considerably reduced.

Mortars are placed at the following distances from the epaulment, when firing at different degrees of elevation, viz.

At	45	degrees	10	feet	At	20	degrees	19 feet
„	35	„	12	„	„	15	„	30 „
„	30	„	14	„	„	10	„	56 „
„	25	„	17	„	„	5	„	80 „

When it may be desirable to fire at low angles, the hind part of the bed may be raised by wedges, until the Mortar is at the required elevation, which is generally determined by the quadrant.

These wedges should be of the same length as the Mortar bed, the cheeks of which, ought to bear on their upper surface.

The epaulment of the Battery is generally so high, that from the Mortar itself, the object or place to be fired at, can seldom be seen, two ramrods are therefore stuck in the superior slope of the battery, in line with the object.

To fix these rods properly, the Officer places himself in rear of the Mortar, on something which may enable him to see the object to be fired at over the epaulment, and by a plummet and line, he will determine the alignment, between the axis of the Mortar and the object, a man mounts on the epaulment with the rods, places himself near the crest of it, and turns his right side towards the Mortar.

The Officer orders him to move forward or back, till he sees him to be nearly in the alignment, when he gives the word " Halt," the man drops on his right knee and holds out one of the rods perpendicularly, the Officer then gives the word " to you" or " from you," as the case may require, and when he perceives the rod to be in the alignment, he says, " plant it there" the man thrusts it firmly into the parapet, the Officer taking care that it be perfectly vertical.

8. Should there be nothing at hand for the Officer to mount on, he can get on the cap-squares of the bed.

The man then shifts about 6 feet to his left, and under the direction of the Officer, plants the other rod in a similar way ; after which he receives the word " come down."

Pointing rods are sometimes fixed in 2½ or 3 inch planks, about 7 or 8 feet in length, prepared for the purpose. In this case a man mounts on something laid behind the epaulment, and places the board on the superior slope, under the direction of the Officer.

Firing by Night.

To ensure as accurate a degree of fire as possible during the night, the following mode has been adopted.

After the Mortar has been accurately laid during the day, a plank is placed outside of, and touching one of the cheeks, of the bed, and nailed or secured to the platform,* the plank must be thin enough to go under the running up bolts, which should not bear upon it ; every time the Mortar is fired, it is to be run to the same position.

Night firing is generally limited to a few rounds, at intervals, for the purpose of general annoyance, and to disturb working parties.

A lanthorn is necessary to adjust the elevation.

Rules to be observed in laying and Loading Mortars.

The accuracy of Mortar practice depends on so many circumstances, that nothing but actual experience can ensure shells being thrown correctly.

Great variation often takes place under circumstances absolutely similar ; not all the Science of Artillery has been able to correct the discrepancies occasioned by variations in ordnance, quality of the powder, the projectile, the windage, &c.

The following points must be attended to, as soon as all the men are told off; and the Officer in charge of each Mortar, cannot be too careful in superintending every operation.

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* With the treversing platforms the plank must be secured to the sleepers, outside one of the cheeks of the platform.

These observations may appear minute, and even childish, but the omission of the simplest precaution, often destroys in a great measure, the effects of Artillery, and important results are lost.

1st.—The calibre compasses should be used to ascertain the correctness of the Mortar and Shell, that there is only the due proportion of windage, that the shell is of the proper weight, and that the mortar exactly fits the bed: that the platform is quite level, otherwise no good practice can ensue.

2d.—The mortar should then be scaled, for the quantity of powder allowed for scaling, vide page 55.

Scaling is only necessary at the commencement of practice.

3d.—The mortar is then to be laid for the range, for which it must be brought up square with the front of the platform, and placed exactly on its centre.

4th.—The axis of the mortar is taken. To fix the axis, three points or centres are necessary, one is taken at the muzzle, one at the reinforce ring, and the third near the vent.

This is done with the perpendicular, and afterwards a chalked thread or line is drawn over these points, and if it exactly covers them, the centres are correctly taken—if not, the same process must be gone over until they agree.

5th.—The mortar is now to be laid for the object with a silk plummet line. The person laying the mortar must place himself exactly behind it and holding the plummet line with his right hand above his right eye, steadying it with his left hand, and get it to cover the chalked line exactly, as well as the object he may be firing at, or, where the object cannot be seen, the pointing rods.

6th.—The elevation is then given with a quadrant: the shank of the quadrant is laid along the bottom of the bore, pressed by the hand close to the metal, it must not touch the shell.

The quadrant should be laid as near as possible with the axis of the piece, a man standing to the rear of the mortar, will easily regulate its true position, and cause the arc of the quadrant to be in line with the centre of the mortar. It is not necessary that the bubble should be in the centre of the glass, but the whole of it must be distinctly seen.

In taking out the quadrant, invariably examine the index, for it is very apt to move from its place.

7th.—The mortar may now be loaded. Priming, with cartridges, tubes must be used, with loose powder quick match: one end of the match is placed to the vent, so as to reach the middle of the charge, and the other end folded two or three turns over itself close to the top of the vent—the thumb must be kept on it, until the charge has been pressed home.

With Cartridge.—The Cartridge is put in the chamber and pressed well home with the hand, care being taken, that some part of the cartridge (but not the seam) be so placed as to touch the vent.

Loose Powder.—The powder weighed by a careful person, is brought up to the mortar in a copper or tin measure called a cylinder, the quick match having been placed in the vent, the powder is put into the chamber, and carefully set up with the hand.

The shell previously prepared is brought up and after having been carefully wiped, is let into the mortar, the shell being placed with the plug or fuze exactly in the axis of the piece.

Cant or hand hooks are used for the 13 and 10 inch shells, and bearing leathers for the lower calibres.

8th.—After being thus carefully loaded, both direction and elevation, are, if required, corrected.

9th.—The fuze is uncapped and dredged, the quick match or tube is also dredged and the sheep skin placed in the bore to prevent any sparks from the nearest mortar when fired igniting the fuze.

10th.—When the order is given to fire; the sheep skin is taken out of the mortar, and the slow match brought so as to touch the front part of the priming and be as far as possible from the explosion, a steady person should be at the plummet stand, to take the shell's flight, and another should be on the look out, to give notice when the shell reaches the ground, when he observes this, he calls out loudly "*down.*"

This is necessary when firing either fuzed or plugged shells; with fuzed shells, the starting of the fuze should be carefully noticed; after the mortar has been discharged it must be run up.

Every minutia ought to be attended to with a care and scrupulosity bordering on fastidiousness, without it, an Artilleryman will never make good practice, and with it, he must often expect results different from what he anticipated, this, however, should not discourage him, on the contrary, it should excite him in his endeavours to overcome all difficulties, and if possible discover the causes of discrepancies.

Rule for calculating Char~~ges~~. [illegible]

The following theoretical rule is given, in order to ascertain the ~~charge~~. [illegible]

As the sine of double the given angle, is to the sine of double the proposed angle, so is the range of the first angle, to the range of the latter.

To find the time of flight for any Range.

1st.—To find the time of flight, the range being given at an elevation of 45_0.

Divide the square root of the given range in feet by 4, and the product will be the time of flight in seconds.

2d.—To find the range, the time of flight being given, with an angle of 45°.

Multiply the time of flight by 4, and then square the product for the range in feet.

The flight of Shells at angles above and below 45° are, as the sines of the angles of elevation.

To find the length of Fuze for any Range.

Multiply the time of flight by ·2 which are the decimal parts of an inch each fuze burns in a second of time, and the product will be the length in inches and parts.

In preparing fuzes, half a tenth, more or less, is of no consequence.

When the time of Fuzes burning is not known.

Burn one or two fuzes of each nature and note the number of seconds they take to burn through an inch.

Having ascertained this, look in the table for the number of seconds, and cut your fuze accordingly.

The accuracy of mortar practice depends on so many circumstances that actual experience only can ensure shells being thrown with precision. A variety of theoretical rules have been given, but good tables of practice are the best guide.

When mortars or shells are of incorrect dimensions, no good practice can be made.

TABLE OF SINES.

degrees.	sines.	degrees.	sines.	degrees.	sines.
1	.018	31	.515	61	.875
2	.035	32	.530	62	.883
3	.052	33	.545	63	.891
4	.070	34	.559	64	.898
5	.087	35	.574	65	.906
6	.105	36	.588	66	.914
7	.122	37	.602	67	.921
8	.139	38	.616	68	.927
9	.156	39	.629	69	.934
10	.174	40	.643	70	.940
11	.191	41	.656	71	.946
12	.208	42	.669	72	.951
13	.225	43	.682	73	.956
14	.242	44	.695	74	.961
15	.259	45	.707	75	.966
16	.276	46	.719	76	.970
17	.292	47	.731	77	.974
18	.309	48	.743	78	.978
19	.326	49	.755	79	.982
20	.342	50	.766	80	.985
21	.358	51	.777	81	.988
22	.375	52	.788	82	.990
23	.391	53	.799	83	.993
24	.407	54	.809	84	.995
25	.423	55	.819	85	.996
26	.438	56	.829	86	.998
27	.454	57	.839	87	.999
28	.469	58	.848	88	.999
29	.485	59	.857	89	.999
30	.500	60	.866	90	1.000

Table of the Flight of Shells at various distances and Elevations.

Ranges.	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°
Yards.	sec	sec	sec	sec	sec	sec	sec	sec	sec	sec	sec	sec	sec	sec	sec
150	1	2	2½	3	3¾	4¼	4¾	5¼	5½	6	6¼	6½	7	7¼	7½
200	1¼	2¼	3	3½	4¼	5	5½	6	6½	7	7¼	7½	7¾	8¼	8¼
250	1½	2½	3¼	4	4¾	5½	6¼	6¾	7¼	7¾	8¼	8½	9	9¼	9½
300	1¾	2¾	3½	4½	5¼	6	6¾	7½	8	8½	9	9½	10	10¼	10½
350	2	3	3¾	4¾	5¾	6½	7¼	8	8½	9¼	9¾	10¼	10½	10¾	11
400	2¼	3¼	4¼	5	6	7	8	8¾	9¼	10	10¾	11	11½	11¾	12¼
450	2½	3½	4½	5½	6½	7½	8¼	9¼	10	10¾	11¼	11¾	12¼	12½	12¾
500	2½	3¾	4¾	6	6¾	7¾	8¾	9¾	10½	11¼	12	12½	13	13¼	13½
550	2¾	3¾	5	6¼	7	8¼	9¼	10¼	11	12	12½	13	13½	14	14¼
600	2¾	4	5¼	6½	7½	8½	9¾	10¾	11½	12½	13	13¾	14	14¾	15
650	2¾	4	5¼	6¾	8	9	10	11	12	12¾	13½	14	14½	15	15¼
700	2¾	4¼	5¾	7	8¼	9½	10½	11¾	12½	13½	14¼	15	15¼	15¾	16
750	3	4½	5¾	7¼	8½	9¾	11	12	13	14	14¾	15¼	15¾	16¼	16¾
800	3	4½	6	7¼	8¾	10	11¼	12¼	13¼	14¼	15	15¾	16½	16¾	17
850	3	4¾	6	7½	9	10¼	11½	12¾	13¾	14¾	15½	16	16¾	17¼	17¾
900	3	4¾	6¼	7¾	9¼	10½	11¾	13	14	15	15¾	16½	17¼	17¾	18¼
950	3¼	5	6½	8	9½	10¾	12	13½	14½	15½	16½	17	17¾	18¼	18¾
1000	3¼	5	6¾	8¼	10	11¼	12¾	14	15	16	17	17¾	18½	19	19½
1050	3½	5¼	7	8½	10¼	11¾	13	14½	15¾	16¼	17½	18¼	19	19½	19¾
1100	3½	5¼	7	8¾	10½	12	13¼	14¾	16	16½	18	18¾	19½	20¼	20½
1150	3½	5½	7¼	9	10¾	12	13½	15	16¼	17¼	18¼	19	19¾	20½	21
1200	3¾	5½	7¼	9	11	12¼	14	15¼	16½	17½	18¾	19¼	20¼	20¾	21¼
1250	3¾	5¾	7½	9¼	11	12½	14	15½	16¾	18	19	20	20½	21¼	21¾
1300	3¾	5¾	7¾	9½	11¼	13	14½	16	17¼	18½	19½	20½	21¼	21¾	22
1350	4	6	7¾	9¾	11½	13	14¾	16¼	17½	18¾	19¾	20¾	21½	22	22¼
1400	4	6	8	10	11¾	13½	15	16¾	18	19½	20½	21¼	22	22¾	23
1450	4	6	8¼	10	12	13¾	15¼	17	18¼	19½	20¾	21¾	22½	23¼	23¾
1500	4¼	6¼	8½	10¼	12¼	14	15½	17¼	18½	20	21	22	22¾	23½	24

PRACTICE TABLES.

MEMORANDUM FOR USING THE FOLLOWING TABLES.

The charge being given to find the Range and elevation. In the tables of "Proof range," find the charge for the mortar, and on the same line to the left note the letter; turn to table of "Elevation and ranges" and in the line with the letter noted above, will be found the range and elevation.

The range and elevation being given to find the charge. In the table of "Elevation and Ranges" in the upper column, find the elevation and the range underneath, note the letter on the same line to the left, turn to the table of "Proof Range" according to strength of powder, and in line with the letter will be found the charge.

ELEVATION AND RANGES.

	ELEVATION							
	45°	50° 40°	55° 35°	60° 30°	65° 25°	70° 20°	75° 15°	80° 10°
	RANGES IN YARDS.							
a	300	295	282	259	229	192	150	102
b	350	344	329	303	268	225	175	119
c	400	394	376	346	306	257	200	136
d	450	443	423	389	344	289	225	153
e	500	492	470	433	383	321	250	171
f	550	541	517	476	421	353	275	188
g	600	591	564	519	459	385	300	205
h	650	640	611	562	497	417	325	222
i	700	689	658	606	536	450	350	239
k	750	738	705	649	574	482	375	256
l	800	788	752	692	612	514	400	273
m	850	837	799	736	651	546	425	290
n	900	886	846	779	689	578	450	307
o	950	935	893	822	727	610	475	324
p	1000	985	940	866	766	643	500	342
q	1050	1034	987	909	804	675	525	359
r	1100	1083	1034	952	842	707	550	376
s	1150	1132	1081	995	880	739	575	393
t	1200	1182	1128	1039	919	771	600	410
u	1250	1231	1175	1082	957	803	625	427
v	1300	1280	1222	1125	995	835	650	444
w	1350	1329	1269	1169	1034	868	675	461
x	1400	1379	1316	1212	1072	900	700	478

PROOF RANGE 900 YARDS.

	Mortars.											
	13 inch.			10 inch.			8 inch.			5½ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	13	15	1	1	13	0	11	11	0	5	5
b	2	0	11	1	2	14	0	12	7	0	5	9
c	2	3	10	1	4	4	0	13	1	0	5	13
d	2	6	13	1	5	7	0	14	0	0	6	1
e	2	9	3	1	6	11	0	14	13	0	6	6
f	2	11	3	1	7	15	0	15	11	0	6	8
g	2	13	3	1	9	1	1	0	10	0	7	0
h	2	15	13	1	10	4	1	1	11	0	7	2
i	3	2	0	1	11	4	1	2	8	0	7	7
k	3	3	7	1	12	4	1	3	5	0	7	12
l	3	6	0	1	13	2	1	4	2	0	8	0
m	3	8	3	1	14	5	1	5	1	0	8	4
n	3	10	11	1	15	11	1	6	1	0	0	0
o	3	13	1	2	1	0	1	7	5	0	0	0
p	3	15	11	2	2	8	1	8	0	0	0	0
q	4	2	11	2	3	13	1	8	13	0	0	0
r	4	4	12	2	4	15	1	9	8	0	0	0
s	4	8	0	2	5	15	1	10	2	0	0	0
t	4	11	0	2	7	1	1	11	10	0	0	0

PROOF RANGE 950 YARDS.

	Mortars.											
	13 inch.			10 inch.			8 inch.			5½ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	11	14	1	0	6	0	10	6	0	5	0
b	1	14	6	1	1	8	0	11	2	0	5	4
c	2	1	0	1	3	0	0	11	14	0	5	7
d	2	3	14	1	4	2	0	12	14	0	5	10
e	2	6	2	1	5	6	0	13	12	0	6	1
f	2	7	10	1	6	10	0	14	10	0	6	3
g	2	9	2	1	7	12	0	15	10	0	6	10
h	2	11	14	1	8	14	1	0	10	0	6	12
i	2	14	0	1	9	14	1	1	4	0	7	2
k	2	15	8	1	10	11	1	2	0	0	7	6
l	3	2	8	1	11	6	1	2	12	0	7	10
m	3	4	6	1	12	10	1	3	13	0	7	14
n	3	7	6	1	14	2	1	4	14	0	0	0
o	3	9	9	1	15	8	1	6	4	0	0	0
p	3	12	1	2	1	4	1	6	10	0	0	0
q	3	14	6	2	2	6	1	7	4	0	0	0
r	4	0	14	2	3	10	1	8	0	0	0	0
s	4	4	8	2	4	10	1	8	14	0	0	0
t	4	7	8	2	5	14	1	9	6	0	0	0

PROOF RANGE 1000 YARDS.

	Mortars.														
	13 inch.			10 inch.			8 inch.			$5\frac{1}{2}$ inch.			$4\frac{2}{5}$ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	9	12	0	14	14	0	9	0	0	4	11	0	2	12
b	1	12	0	1	0	1	0	9	14	0	4	15	0	2	14
c	1	14	7	1	1	11	0	10	12	0	5	2	0	3	0
d	2	1	0	1	2	14	0	11	11	0	5	6	0	3	3
e	2	3	0	1	4	2	0	12	10	0	5	11	0	3	6
f	2	4	0	1	5	5	0	13	10	0	5	14	0	3	10
g	2	5	0	1	6	6	0	14	11	0	6	3	0	3	13
h	2	8	0	1	7	7	0	15	9	0	6	7	0	3	15
i	2	10	0	1	8	8	1	0	0	0	6	12	0	4	1
k	2	11	9	1	9	2	1	0	10	0	7	1	0	4	4
l	2	15	0	1	9	10	1	1	10	0	7	4	0	0	0
m	3	0	8	1	11	0	1	2	9	0	7	9	0	0	0
n	3	4	0	1	12	8	1	3	8	0	0	0	0	0	0
o	3	6	0	1	14	0	1	5	2	0	0	0	0	0	0
p	3	8	8	2	0	0	1	5	5	0	0	0	0	0	0
q	3	10	0	2	1	0	1	5	12	0	0	0	0	0	0
r	3	13	0	2	2	4	1	6	8	0	0	0	0	0	0
s	4	1	0	2	3	6	1	7	10	0	0	0	0	0	0
t	4	4	0	2	4	12	1	8	0	0	0	0	0	0	0
u	0	0	0	2	6	4	1	8	10	0	0	0	0	0	0

PROOF RANGE 1050 YARDS.

	MORTARS.														
	13 inch.			10 inch.			8 inch.			5½ inch.			4⅖ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	8	15	0	14	6½	0	8	12½	0	4	7¼	0	2	8
b	1	1	13	0	15	10	0	9	10½	0	4	11	0	2	11¼
c	1	13	9	1	1	2	0	10	7	0	4	14½	0	2	13
d	2	0	2	1	2	5	0	11	4	0	5	2½	0	3	0
e	2	2	3	1	3	7½	0	12	2½	0	5	7	0	3	3
f	2	3	6	1	4	8½	0	13	2½	0	5	10	0	3	6½
g	2	4	8	1	5	9½	0	14	1	0	5	15	0	3	9½
h	2	7	6	1	6	9½	0	14	13	0	6	3	0	3	12
i	2	9	7	1	7	10	0	15	5½	0	6	7½	0	3	14
k	2	11	2	1	8	4½	0	15	14½	0	6	12	0	0	0
l	2	14	7	1	8	14½	1	0	13	0	6	15	0	0	0
m	3	0	0	1	10	3	1	1	9	0	7	4	0	0	0
n	3	3	7	1	11	8	1	2	8	0	0	0	0	0	0
o	3	5	8	1	12	14	1	3	13½	0	0	0	0	0	0
p	3	8	1	1	14	12	1	4	3	0	0	0	0	0	0
q	3	9	11	1	15	13	1	4	11	0	0	0	0	0	0
r	3	12	7	2	1	0	1	5	8	0	0	0	0	0	0
s	4	0	6	2	2	2½	1	6	8½	0	0	0	0	0	0
t	0	0	0	2	3	9	1	7	1	0	0	0	0	0	0

PROOF RANGE 1100 YARDS.

	Mortars.														
	13 inch.			10 inch.			8 inch.			5½ inch.			4⅖ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	8	2	0	13	15	0	8	9	0	4	3½	0	2	4
b	1	10	6	0	15	3	0	9	6	0	4	7½	0	2	8
c	1	12	13	1	0	9	0	10	2	0	4	11	0	2	10
d	1	15	4	1	1	12	0	10	13	0	4	15	0	2	13
e	2	1	6	1	2	13	0	11	11	0	5	3	0	3	0
f	2	2	12	1	3	12	0	12	10	0	5	6	0	3	3
g	2	4	0	1	4	13	0	13	7	0	5	11	0	3	6
h	2	6	12	1	5	11½	0	14	1	0	5	15	0	3	9
i	2	8	9	1	6	12	0	14	10	0	6	3	0	3	11
k	2	10	11	1	7	7	0	15	3	0	6	7	0	0	0
l	2	13	14	1	8	3	1	0	0	0	6	10	0	0	0
m	2	15	9	1	9	6	1	0	9	0	6	15	0	0	0
n	3	2	15	1	10	8	1	1	8	0	0	0	0	0	0
o	3	5	0	1	11	12	1	2	9	0	0	0	0	0	0
p	3	7	9	1	13	8	1	3	1	0	0	0	0	0	0
q	3	9	6	1	14	10	1	3	10	0	0	0	0	0	0
r	3	12	1	1	15	12	1	4	8	0	0	0	0	0	0
s	3	15	12	2	0	15	1	5	7 5	0	0	0	0	0	0
t	0	0	0	2	2	6	1	6	2	0	0	0	0	0	0

PROOF RANGE 1150 YARDS.

	Mortars.														
	13 inch.			10 inch.			8 inch.			5½ inch.			4⅘ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	7	5	0	13	7½	0	8	5½	0	3	15¾	0	2	0
b	1	9	9	0	14	12	0	9	2½	0	4	3¾	0	2	4
c	1	11	15	1	0	0	0	9	11	0	4	7½	0	2	7
d	1	14	6	1	1	3	0	10	6	0	4	11½	0	2	10
e	2	0	9	1	2	2½	0	11	3½	0	4	15	0	2	13
f	2	2	2	1	2	15½	0	12	1½	0	5	2	0	2	½1
g	2	3	8	1	4	½	0	12	13	0	5	7	0	3	2½
h	2	6	2	1	4	14½	0	13	5	0	5	11	0	3	6
i	2	8	0	1	5	14	0	13	15½	0	5	14½	0	3	8
k	2	10	4	1	6	9½	0	14	7½	0	6	2	0	0	0
l	2	13	5	1	7	7½	0	15	3	0	6	5	0	0	0
m	2	15	1	1	8	9	0	15	9	0	6	10	0	0	0
n	3	2	6	1	9	8	1	0	8	0	0	0	0	0	0
o	3	4	8	1	10	10	1	1	4½	0	0	0	0	0	0
p	3	7	1	1	12	4	1	1	15	0	0	0	0	0	0
q	3	9	1	1	13	7	1	2	9	0	0	0	0	0	0
r	3	11	11	1	14	8	1	3	8	0	0	0	0	0	0
s	3	15	2	1	15	11½	1	4	5½	0	0	0	0	0	0
t	0	0	0	2	1	3	1	5	3	0	0	0	0	0	0

PROOF RANGE 1200 YARDS.

	MORTARS.														
	13 inch. *			10 inch.			8 inch.			5½ inch.			4⅖ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	4	8	0	13	0	0	8	2	0	3	12	0	1	15
b	1	6	8	0	14	6	0	9	0	0	4	0	0	2	2½
c	1	8	0	0	15	8	0	9	8	0	4	4	0	2	4½
d	1	10	8	1	0	9	0	9	14	0	4	8	0	2	7
e	1	12	0	1	1	8	0	10	12	0	4	12	0	2	9
f	1	13	8	1	2	10	0	11	8	0	4	15	0	2	12
g	1	15	8	1	3	4	0	12	2	0	5	3	0	2	15
h	2	1	8	1	4	4	0	12	10	0	5	7	0	3	2
i	2	2	8	1	5	0	0	13	2	0	5	10	0	3	5
k	2	4	8	1	5	12	0	13	12	0	5	13	0	0	0
l	2	7	0	1	6	12	0	14	6	0	6	0	0	0	0
m	2	9	0	1	7	12	0	14	10	0	6	4	0	0	0
n	2	11	0	1	8	8	0	15	8	0	6	7	0	0	0
o	2	12	8	1	9	8	1	0	0	0	0	0	0	0	0
p	2	14	8	1	11	0	1	0	12	0	0	0	0	0	0
q	3	0	0	1	12	4	1	1	8	0	0	0	0	0	0
r	3	2	0	1	13	4	1	2	8	0	0	0	0	0	0
s	3	4	0	1	14	8	1	3	4	0	0	0	0	0	0
t	3	6	8	2	0	0	1	4	4	0	0	0	0	0	0

* Vide page 76.

PROOF RANGE 1250 YARDS.

	Mortars.														
	13 inch.			10 inch.			8 inch.			5½ inch.			4⅖ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	5	9	0	12	2	0	7	10½	0	3	7½	0	1	14
b	1	7	15	0	13	15	0	8	8	0	3	12	0	2	0
c	1	10	3	0	14	6	0	9	0	0	3	15	0	2	1½
d	1	12	10	0	15	7	0	9	6½	0	4	2	0	2	4
e	1	14	15	1	0	6	0	10	3	0	4	6	0	2	6
f	2	0	12	1	1	8	0	10	14	0	4	9	0	2	9
g	2	2	8	1	2	4	0	11	9	0	4	13	0	2	12
h	2	4	14	1	3	5	0	12	2	0	5	1	0	2	14½
i	2	6	12	1	4	3	0	12	10	0	5	3½	0	3	1
k	2	9	13	1	5	1	0	12	13	0	5	6½	0	0	0
l	2	11	15	1	6	3	0	13	14	0	5	10	0	0	0
m	2	14	5	1	7	3	0	14	3	0	5	14½	0	0	0
n	3	1	4	1	8	0	0	15	½	0	6	1½	0	0	0
o	3	3	10	1	8	15	0	15	9	0	0	0	0	0	0
p	3	6	5	1	10	6	1	0	4½	0	0	0	0	0	0
q	3	8	7	1	11	8	1	1	½	0	0	0	0	0	0
r	3	11	1	1	12	7	1	2	½	0	0	0	0	0	0
s	3	13	14	1	13	11	1	2	11½	0	0	0	0	0	0
t	0	0	0	1	15	2	1	3	12½	0	0	0	0	0	0
u	0	0	0	2	0	0	1	4	10	0	0	0	0	0	0

PROOF RANGE 1300 YARDS.

	MORTARS.														
	13 inch.			10 inch.			8 inch.			5½ inch.			4⅖ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	4	11	0	11	4	0	7	3	0	3	2	0	1	11
b	1	7	2	0	12	4	0	8	0	0	3	8	0	1	13
c	1	9	5	0	13	4	0	8	8	0	3	10	0	1	15
d	1	11	12	0	14	5	0	8	15	0	3	12	0	2	1
e	1	14	0	0	15	4	0	9	10	0	4	0	0	2	3
f	2	0	1	1	0	6	0	10	4	0	4	3	0	2	6
g	2	2	0	1	1	4	0	11	0	0	4	7	0	2	9
h	2	4	4	1	2	6	0	11	10	0	4	11	0	2	11
i	2	6	2	1	3	6	0	12	2	0	4	13	0	2	13
k	2	9	6	1	4	6	0	12	8	0	5	0	0	0	0
l	2	11	4	1	5	10	0	13	6	0	5	4	0	0	0
m	2	13	15	1	6	10	0	13	12	0	5	9	0	0	0
n	3	0	11	1	7	8	0	14	9	0	5	12	0	0	0
o	3	3	3	1	8	5	0	15	2	0	0	0	0	0	0
p	3	5	15	1	9	10	0	15	13	0	0	0	0	0	0
q	3	8	2	1	10	12	1	0	9	0	0	0	0	0	0
r	3	10	12	1	11	12	1	1	9	0	0	0	0	0	0
s	3	13	4	1	12	14	1	2	3	0	0	0	0	0	0
t	0	0	0	1	14	0	1	3	7	0	0	0	0	0	0
u	0	0	0	1	15	0	1	4	3	0	0	0	0	0	0
v	0	0	0	2	0	0	1	5	2	0	0	0	0	0	0

PROOF RANGE 1350 YARDS.

	Mortars.														
	13 inch.			10 inch.			8 inch.			5½ inch.			4⅖ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	3	12	0	10	6	0	6	11½	0	2	13½	0	1	8
b	1	6	5	0	11	3	0	7	8	0	3	4	0	1	10
c	1	8	7	0	12	2	0	8	0	0	3	6	0	1	13
d	1	10	14	0	13	3	0	8	7½	0	3	8	0	1	14
e	1	13	3	0	14	2	0	9	1	0	3	10	0	2	0
f	1	15	7	0	15	4	0	9	10	0	3	13	0	2	3
g	2	1	8	1	0	4	0	10	7	0	4	1	0	2	6
h	2	3	10	1	1	7	0	11	2	0	4	5	0	2	7½
i	2	5	8	1	2	9	0	11	10	0	4	6½	0	2	9
k	2	8	15	1	3	11	0	12	3	0	4	9½	0	0	0
l	2	10	9	1	5	1	0	12	14	0	4	14	0	0	0
m	2	13	9	1	6	1	0	13	5	0	5	3½	0	0	0
n	3	0	2	1	7	0	0	14	1½	0	5	6½	0	0	0
o	3	2	12	1	7	12	0	14	9	0	0	0	0	0	0
p	3	5	9	1	9	2	0	15	5½	0	0	0	0	0	0
q	3	7	13	1	10	0	1	0	1½	0	0	0	0	0	0
r	3	10	7	1	10	13	1	1	1½	0	0	0	0	0	0
s	3	12	10	1	12	1	1	1	10½	0	0	0	0	0	0
t	0	0	0	1	13	2	1	3	½	0	0	0	0	0	0
u	0	0	0	1	14	0	1	4	6	0	0	0	0	0	0
v	0	0	0	1	15	2	1	5	10	0	0	0	0	0	0
w	0	0	0	2	0	0	1	7	0	0	0	0	0	0	0

PROOF RANGE 1400 YARDS.

	Mortars.														
	13 inch.			10 inch.			8 inch.			5½ inch.			4⅖ inch.		
	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.	lbs.	oz.	drs.
a	1	3	0	0	9	7	0	6	4	o	2	6	o	1	5
b	1	5	8	0	10	0	0	7	0	o	2	9	o	1	7
c	1	7	8	0	10	13	0	7	8	o	2	15	o	1	9
d	1	10	0	0	12	0	0	8	0	o	3	1	o	1	11⅓
e	1	12	8	0	13	0	0	8	8	o	3	5	o	1	14
f	1	15	0	0	14	2	0	9	0	o	3	8	o	2	0
g	2	1	0	0	15	6	0	9	14	o	3	10	o	2	2
h	2	3	0	1	0	7	0	10	10	o	3	14	o	2	4
i	2	5	4	1	1	12	0	11	2	o	4	0	o	2	6
k	2	8	0	1	3	0	0	11	14	o	4	3	o	2	8
l	2	10	8	1	4	4	0	12	6	o	4	8	o	2	10
m	2	13	0	1	5	8	0	12	14	o	4	14	o	o	o
n	2	15	8	1	6	8	0	13	10	o	5	1	o	o	o
o	3	2	4	1	7	4	0	14	4	o	o	o	o	o	o
p	3	5	0	1	8	6	0	14	14	o	o	o	o	o	o
q	3	7	8	1	9	4	0	15	10	o	o	o	o	o	o
r	3	10	0	1	10	0	1	0	10	o	o	o	o	o	o
s	3	12	0	1	11	4	1	1	2	o	o	o	o	o	o
t	0	0	0	1	12	8	1	1	14	o	o	o	o	o	o
u	0	0	0	1	13	8	1	2	10	o	o	o	o	o	o
v	0	0	0	1	14	6	1	3	3	o	o	o	o	o	o
w	0	0	0	1	15	1	1	4	0	o	o	o	o	o	o
x	0	0	0	2	0	0	1	4	14	o	o	o	o	o	o

The above practice, with the exception of 1200 yards proof, was made from a 13-inch Mortar, too high, that of 1200 yards proof, with a Mortar of the least possible windage, which will account for the considerable difference in range between the 13-inch Mortar, viz. with powder of 1200 yards proof 2 10 8 the difference in range was 257 yards. The other Mortars were all tolerably correct.

The above shews how fallacious calculations must be, if Mortars and Shells are not of correct dimensions.

Besides Shells, Carcasses, Light Balls, Hand Grenades and Pound Stones are frequently thrown from Mortars.

CARCASSES.

They are of Iron like Shells, only having three holes; they are filled with a peculiar composition which burns with great power and fury from 8 to 10 minutes; Carcasses are not intended to burst, the flame rushes out of the three holes, firing every thing within its influence.

Table of Carcasses.

Nature.	Diameter	Weight.			
		Empty.		Filled.	
	Inches.	lbs.	oz.	lbs.	oz.
13 Inch...............	12.84	195	0	212	14
10 „	9.85	90	4	97	8
8 „	7.85	48	0	50	14
5½ „ or 24 Pdrs.......	5.54	15	6	16	9½
4⅖ „ or 12 „	4.44	8	6	8	13

Table of Practice

Brass Mortars.						Iron Mortars.					
Calibre.	Charge.			Eleva-tion.	Dist.	Calibre.	Charge.			Eleva-tion.	Dist.
	lbs.	oz.	drs.				lbs.	oz.	drs.		
10 Inch.	1	0	0	45°	390	10 Inch.	1	2	0	45°	400
„ „	1	5	0	0	485	„ „	1	5	0	0	500
„ „	1	8	0	0	730	„ „	1	8	0	0	590
„ „	2	0	0	0	980	„ „	1	10	0	0	620
8 „	0	11	0	0	510	„ „	1	13	0	0	780
„ „	0	14	0	0	800	„ „	2	0	0	0	935
„ „	1	2	0	0	1000	„ „	2	1	0	0	950
„ „	1	4	0	0	1080	8 „	0	14	0	0	585
						„ „	0	15	8	0	630
						„ „	1	1	8	0	758
						„ „	1	3	0	0	805

LIGHT BALLS.

Light Balls are made of Paper, and in shape and in number of Fuze holes resemble Carcasses.

They are not intended to burst, but through the Fuze holes to throw out a strong light, they are useful at sieges to discover working parties and so enable the Artillery to open on them—also in throwing light in the ditch when storming.

They are fired at low Elevations and in consequence of the weakness of the paper case, a piece of turf or a little oakum should always be placed between the charge and Light Ball to prevent the latter being destroyed by the explosion.

Table of Light Balls.

Nature of Ball.	Weight.				Diameter.		Thickness of Case.	Diam. of fuze hole.	
	Empty.		Filled.		Interior.	Exterior.		Exterior.	Interior.
	lbs.	oz.	lbs.	oz.	ins.	ins.	ins.	ins.	ins.
13 Inch.......	14	8	28	0	9.60	12.80	1.60	1.84	1.70
10 do.........	7	6	16	0	7.00	9.80	1.40	1.57	1.45
8 do.........	3	12	6	12	5.60	7.80	1.10	1.325	1.227
5½ do.........	1	2	3	8	4.04	5.54	.75	.894	.826
4⅖ do.........	0	0	0	0	3.20	4.40	.60	.832	.769

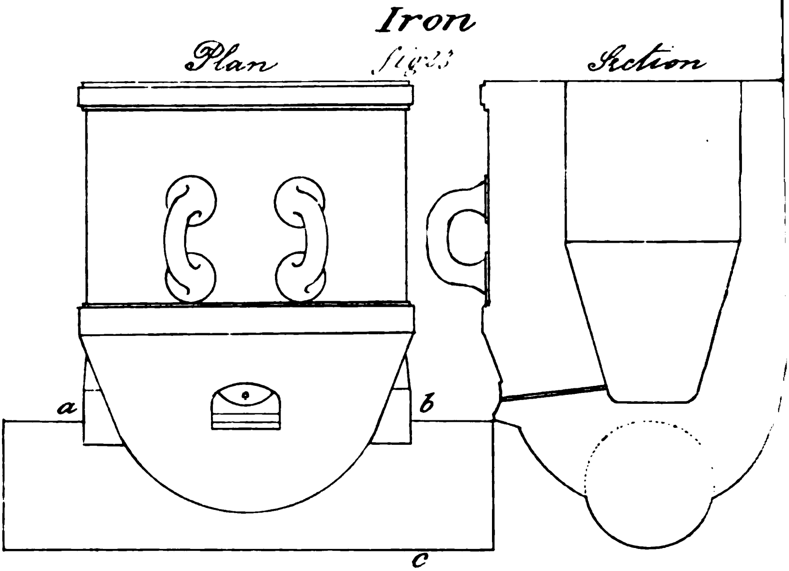


Table of L

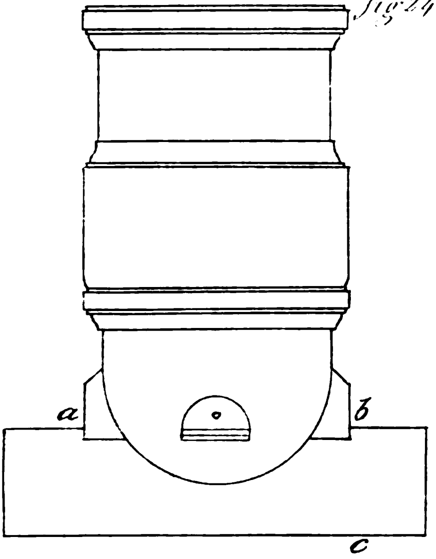
	Weight			Length	
	cwt.	qrs	lbs	Mortar ins.	Chamber ins
13 Inch Iron	36	.	.	36.6	13
10 . .	16	2	.	28.15	10
8 . .	8	2	14	22.8	8
13 . Brass	25	1	.	43.5	14
10 . .	12	.	.	32.5	9.5
8 . .	6	2	.	26.	[illegible]
5½ . .	1	3		16.5	5.4
4⅖ . .		3	11	14.7	3.7

llery.

tars

Brass

Plan



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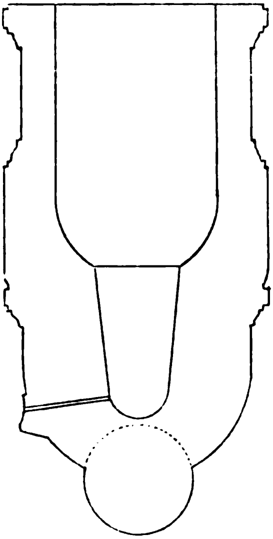

imensions.

		Diameter									
of ore		of Bore		at a b		at b c		Chamber			
								Sup:		Inf:	
s	ths	ins	ths	ins	ths	ins	ths	ins	ths	in	ths.
6	.	13		26	7	9	8	13	.	7	5
9	.	10	.	20	5	7	4·5	10		5	.
6		8	.	16	2·5	6		8	.	4	.
[illegible]	8	13	.	21	8	7	1·5	6	8	3	6
6	8	10	.	16	1·5	6	3	5	.	2	8
[illegible]	3	8	.	12	9	5	.	4	1	2	3
[illegible]	8	5	66	8	2	2	7·5	2	8	2	.
[illegible]		4	5·2	7	3·5	2	2	2	2	1	5

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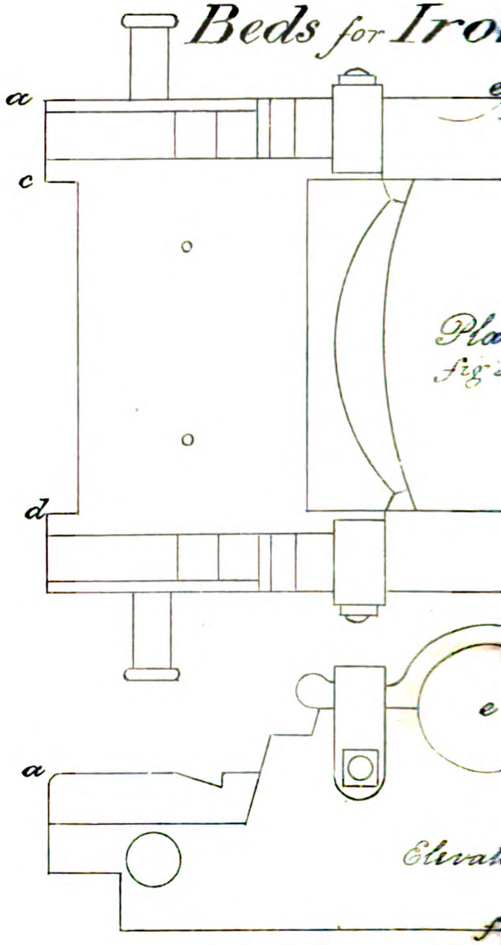
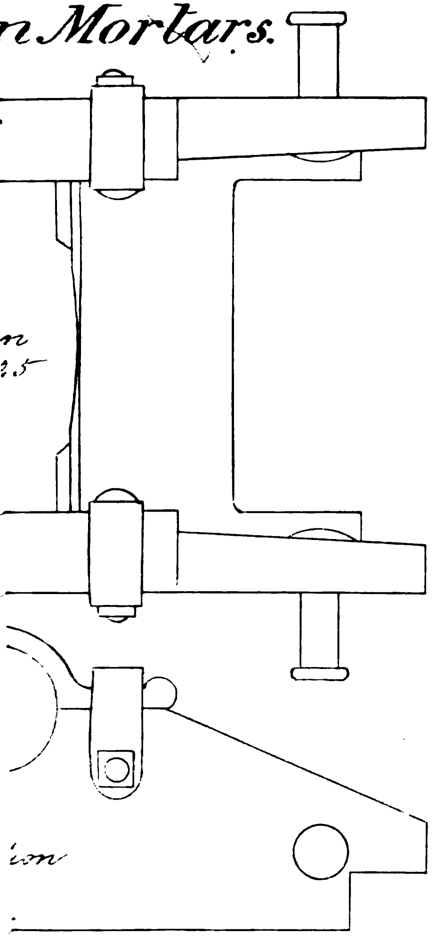


Table of Di

	Weight,			
				a
	cwt	qrs	lbs	ins
13 Inch Iron	52	3	7	68
10 " "	21	1	17	54
8 " "	12	1	4	42
13 " Wooden				
10 " "	17	1	21	84
8 " "	9	2	.	67

lery.

n Mortars.



mensions.

	Length from							
b	a to c		c to d		a to e		e to f	
ths	ins	ths	ins	ths	ins	ths	ins	ths
.	6	5	26	7	34	.	18	.
.	5	.	20	5	27	.	13	7.5
.	4	.	16	2.5	21	.	12	.
			26	7				
.	7	.	20	5	37	2.5	18	5
.	6	.	16	2.5	27	.	17	.

Beds for

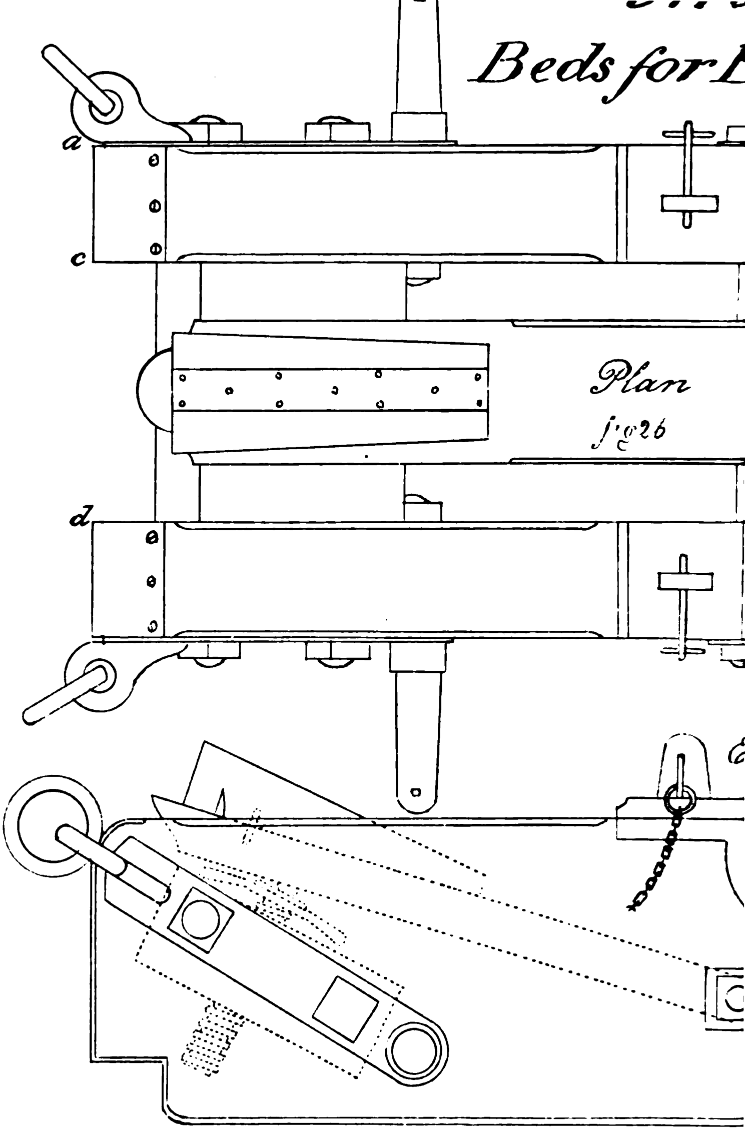
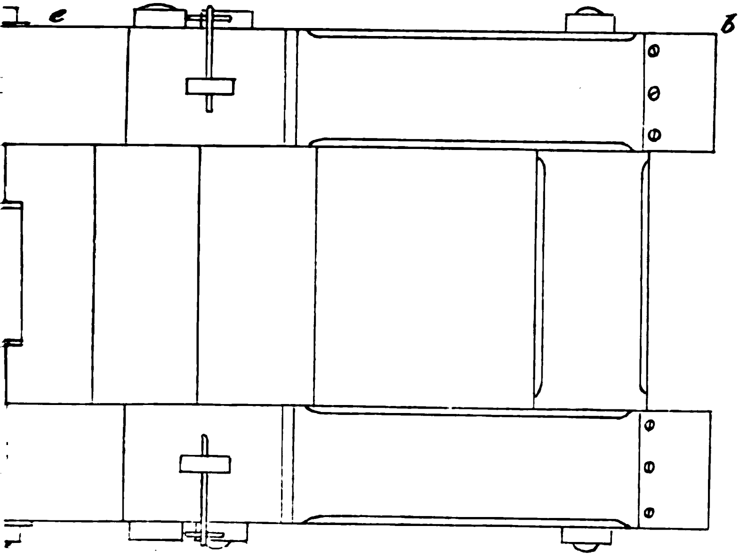


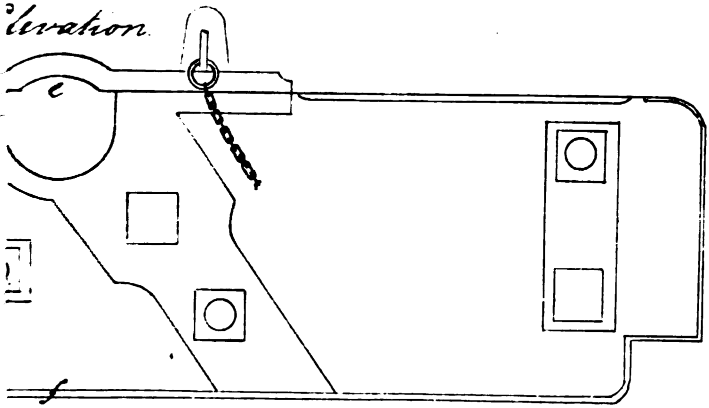
Table of Di

	Weight			a to
	cwt	qrs	lbs	ins
13 Inch Wooden	23	.	.	84
10 — " — " —	16	1	5	84
8 — . — " —	6	.	.	67
5½ — . — " —	4	.	16	54
4⅖ — . — . —	1	2	.	36

rass Mortars.



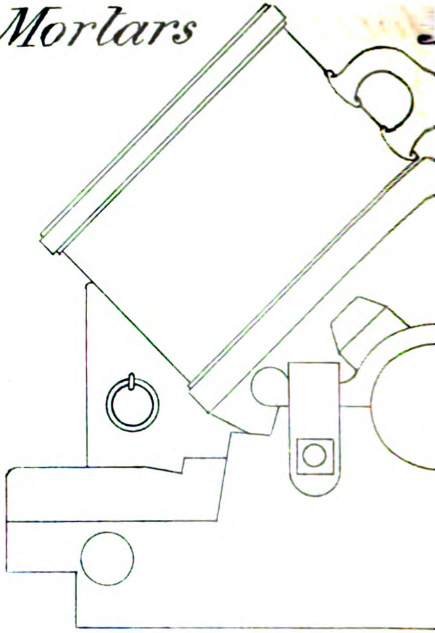
levation

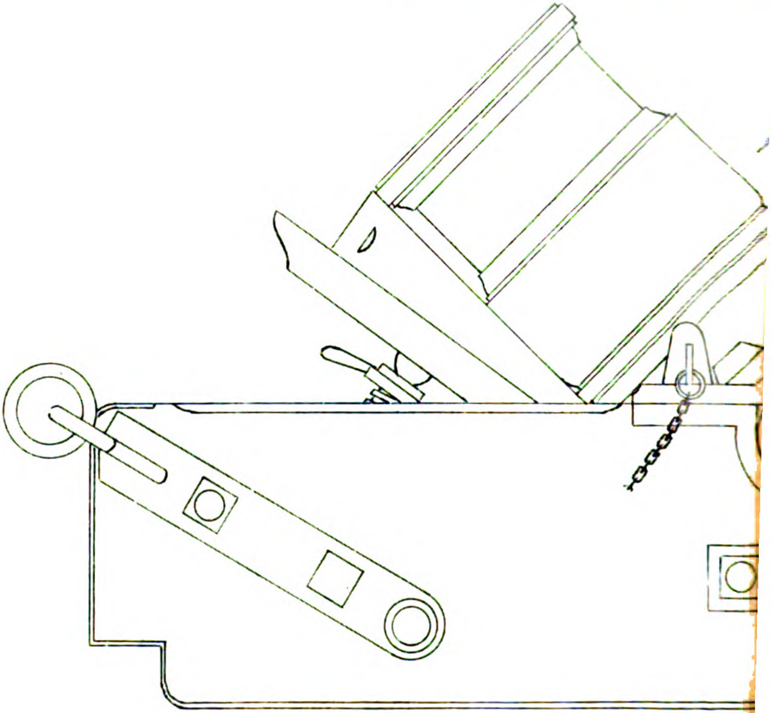


mensions.

	Length from							
b	a to c		c to d		a to e		e to f	
ths.	ins.	ths	ins	ths	ins	ths	ins	ths.
.	10	.	21	8	45	.	18	.
.	7	.	16	1·5	45	.	20	.
.	6	.	12	9	30	.	16	.
.	4	.	8	2	27	.	15	5
.	3	.	7	3·5			10	5

Mortars

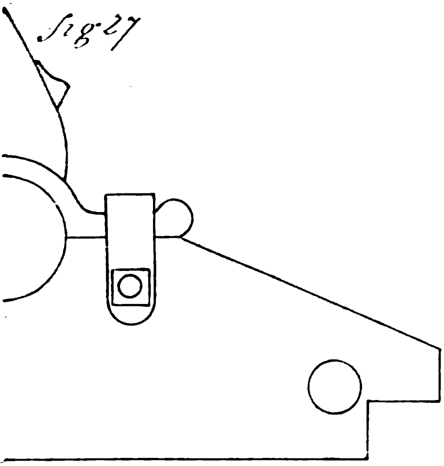




Mounted.

Iron

fig. 27



Brass.

fig. 28

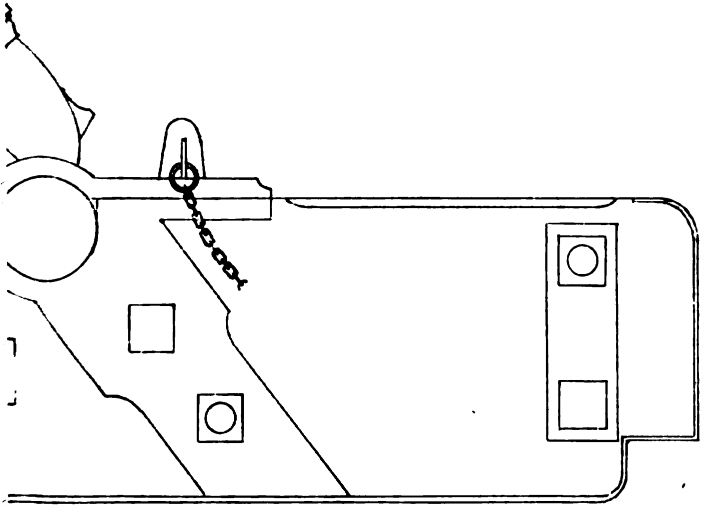


Table of Practice.

Nature of Mortar.	Charge.			Elevation.		Dist
	lbs.	oz.	drs.	D.	M.	yds.
10 Inch Brass	1	0	0	45	0	520
do.	0	10	0	45	0	385
do.	0	10	0	30	0	335
do.	0	12	0	30	0	360
do.	1	0	0	20	0	300
8 do.	0	14	0	45	0	570
do.	0	8	0	45	0	415
do.	0	10	0	30	0	578
do.	0	8	0	30	0	435
do.	0	12	0	20	0	500
5½ do.	0	4	0	45	0	400
do.	0	4	0	42	0	420
do.	0	4	0	30	0	308
do.	0	5	0	20	0	450
10 Inch Iron	1	0	0	45	0	330
do.	0	12	0	45	0	245
do.	0	15	0	37	0	338
8 do.	0	14	0	45	0	400
do.	0	8	0	45	0	241
do.	0	10	0	42	0	332

HAND GRENADES.

Hand Grenades are small hollow shot, filled with powder and fuzed; their diameter is 2,77 inches and their weight 1lb. 13oz.

They are the smallest hollow projectiles in use at present.

Grenades are filled with powder, and furnished with a fuze that will burn 15 seconds; as many Grenades are put in a basket as it will hold—they are laid in layers, the Fuzes uncapped and placed upwards, so that the priming may not fall out. The upper layer is covered with straw or dry grass, kept down by pieces of wood passed through the basket.

33° of Elevation has been found the best angle, because when fired at this angle, the grenades do not bury themselves —half a pound of powder has been fixed on as the best charge, it gives a medium range of 80 yards as the point where the greatest effect is produced and extreme ranges from 45° to 130 Yards.

Grenades will cover with effect by their fall a radius of 12 or 15 yards, each Grenade produces from 12 to 15 splinters of various sizes, these splinters are deadly as far as 10 yards and some are sent as far as 30 yards.

Care must be had to fire them with a slow match, so as to allow the people who use them, time to get under cover, otherwise some Grenades with flaws, may burst in quitting the piece.

A hand Grenade may be thrown from 28 to 30 yards.

STONES.

Stones should be fired with an angle of 60°, so as to give the stones the greater strength of percussion.

Large charges should not be used, they break the stones in small fragments and cause great spreading.

The charge must be covered over with a plank or piece of wood, and on this the basket containing stones must be placed.

The total weight of the stones should be from 90 to 100 lbs.—the piece of wood 5 lbs—Granite stones are best, as they are least likely to break.

CAPTAIN SMITH'S INSTRUMENT.

A Gunner's sliding rule, an instrument intended to supersede the calculations now required in Gunnery,has been invented by Captain Smith of the Madras Engineers, and a comparison of its merit with actual Practice has been made by Lieutenant and Quarter Master Moore of the 2d Battalion Artillery, which proves the instrument to be very correct, and hence very useful.

Calculations on Captain Smith's sliding Gunners scale, compared with actual ranges, charges, times of flight, and length of fuzes, ascertained from practice carried on at Saint Thomas's Mount, with 8-inch and 10-inch Iron mortars. The object of this comparison being to discover whether, in the event of an Iron 10-inch Mortar giving a range equal to one, marked on one of the scales, the calculations on that scale could be applied in practice with those Mortars. The scales were constructed and the compilations made for the purpose of being used with Brass Mortars.

The sign + is prefixed in the column of remarks when either the charge, time of flight, or length of fuze, given by the sliding scale is in excess of the charge, time of flight, or length of fuze ascertained by actual practice ; and the sign — when less.

On inspection of the Table, we see that the charges, time of flight, and length of fuze indicated by the sliding scale approach nearer to those used in actual practice, when they are applied to ranges under 600 yards, and that a greater difference is found to exist when the ranges are higher, but still to so trifling an extent as in no way to preclude the calculations on the scale from being advantageously adopted for practical purposes.

If Gunpowder by any future improvement in its manufacture, should be rendered capable of giving higher proof ranges than at present, the discrepancy between actual results and the calculations on the scale will be slightly increased, that is to say, the deficiency in the latter will be greater.

PRACTICE OF 1837. PROOF RANGE $1142\frac{2}{3}$ YARDS.

DISTANCE.	Charge by scale.			Charge used.			Fuze by scale.		Fuze used.		Time of Flight by scale.	Time of Flight ascertained.	REMARKS.				
													Difference of charge.			Difference of Time.	Difference of Fuze.
	lbs.	oz.	drs.	lbs.	oz.	drs.	ins.	ths.	ins.	ths.	sec.	sec.	lbs.	oz.	drs.	sec.	ths.
No. 1.—10 *in. Mortar.*																	
568 Yards..............	1	3	10	1	4	0	2	0	2	1	$10\frac{1}{4}$	11	— 0	0	6	— $\frac{3}{4}$	— .1
770 „	1	7	1	1	8	0	2	4	2	4	12	12	— 0	0	15	0	.0
889 „	1	9	7	1	12	0	2	5	2	7	$12\frac{3}{4}$	13	— 0	0	9	— $\frac{1}{4}$	— .2
1013 „	1	12	12	1	11	8	2	7	2	9	$13\frac{9}{12}$	$14\frac{2}{12}$	+ 0	1	4	— $\frac{5}{12}$	— .2
1106 „	1	14	14	2	0	0	2	8	3	0	$14\frac{1}{4}$	15	— 0	1	2	— $\frac{3}{4}$	— .2
782 „	1	7	4	1	8	8	2	4	2	4	12	12	— 0	1	4	0	.0
No. 2.—10 *in. Mortar.*																	
481 Yards..............	1	1	14	1	0	0	1	9	1	8	$9\frac{1}{2}$	$9\frac{1}{4}$	+ 0	1	14	+ $\frac{1}{4}$	+ .1
521 „	1	2	11	1	2	0	2	0	2	1	$9\frac{3}{4}$	10	+ 0	0	11	— $\frac{1}{4}$	— .1
796 „	1	7	9	1	8	0	2	4	2	3	$12\frac{1}{4}$	$12\frac{1}{3}$	— 0	0	7	— $\frac{1}{12}$	+ .1
1132 „	1	15	8	2	0	0	2	9	3	0	$14\frac{1}{2}$	$15\frac{1}{4}$	— 0	0	8	— $\frac{3}{4}$	— .1
1018 „	1	12	14	1	14	0	2	8	2	9	14	$14\frac{1}{4}$	— 0	1	2	— $\frac{1}{4}$	— .1
780 „	1	7	4	1	8	8	2	4	2	4	12	$12\frac{1}{12}$	— 0	1	4	— $\frac{1}{12}$	.0

No.* 1.—8 *in. Mortar.																				
568 Yards..............	0	12	10	0	12	0	2	0	2	0	10¼	10	+	0	0	10	+	¼		.0
655 "	0	13	9	0	13	4	2	2	2	1	11	11⅓	+	0	0	5	—	⅓	+	.1
720 "	0	14	3	0	14	8	2	3	2	3	11⅓	11⅔	—	0	0	5	—	⅙		.0
906 "	1	0	3	1	1	0	2	6	2	6	12⅞	13⅙	—	0	0	13	—	$\frac{7}{24}$		.0
966 "	1	1	11	1	2	4	2	7	2	5	13¼	13¼	—	0	0	9		0	+	.2
788 "	0	15	2	0	15	6	2	4	2	4	12	12	—	0	0	4		0		.0
1112 "	1	3	14	1	14	12	2	8	3	0	14¼	15	—	0	0	14	—	¾	—	.2
1226 "	1	3	13	1	6	0	3	0	3	1	15	15½	—	0	0	3	—	½	—	.1
No.* 2.—8 *in. Mortar.																				
660 Yards..............	0	13	9	0	13	4	2	2	2	1	11	11⅓	+	0	0	5	—	⅓	+	.1
770 "	0	14	14	0	15	2	2	4	2	4	12	12⅓	—	0	0	4	—	⅓		.0
996 "	1	2	2	1	2	4	2	7	2	5	13½	13½	—	0	0	2		0	+	.2
1008 "	1	2	3	1	3	8	2	7	2	8	13¾	14¼	—	0	1	5	—	½	—	.1
1136 "	1	4	4	1	4	2	2	9	3	0	14½	15	+	0	0	2	—	½	—	.1
1267 "	1	6	8	1	6	0	3	1	3	1	15¼	15¾	+	0	0	8	—	½		.0
No.* 4.—8 *in. Mortar.																				
564 Yards..............	0	12	10	0	12	0	2	0	2	0	10¼	11	+	0	0	10	—	¾		.0
655 "	0	13	9	0	13	4	2	2	2	3	11	11	+	0	0	5		0	—	.1
940 "	1	1	2	0	15	12	2	6	2	5	13⅛	13	+	0	1	6	+	⅛	+	.1
787 "	0	15	2	0	15	6	2	4	2	4	12	12¾	—	0	0	4	—	¾		.0
1126 "	1	4	2	1	4	12	2	9	3	0	14½	15⅙	—	0	0	10	—	⅔	—	.1
1210 "	1	5	8	1	6	0	3	0	3	1	15	15½	—	0	0	8	—	½	—	.1

PRACTICE OF 183 8. PROOF RANGE 1161 YARDS.

DISTANCE.	Charge by scale.			Charge used.			Fuze by scale.		Fuze used.		Time of Flight by scale.	Time of Flight ascertained.	REMARKS.				
													Difference of charge.			Difference of Time.	Difference of Fuze.
	lbs.	oz.	drs.	lbs.	oz.	drs.	ins.	ths.	ins.	ths.	sec.	sec.	lbs.	oz.	drs.	sec.	ths.
No. 1.—10 *inch Mortar.*																	
594 Yards	1	3	13	1	4	10	2	1	2	0	10½	10½	— 0	0	13	0	+ ·1
612 „	1	4	2	1	5	0	2	1	2	0	10½	11¼	— 0	0	14	— ¾	+ ·1
778 „	1	6	14	1	8	8	2	4	2	5	12	14⅕	— 0	1	10	— 2⅕	— ·1
1028 „	1	12	10	1	14	0	2	7	2	8	13¾	14¼	— 0	1	6	— ½	— ·1
1142 „	1	15	6	2	1	0	2	9	3	0	14⅓	14⅚	— 0	1	10	— ⅓	— ·1
1199 „	2	0	15	2	2	6	3	0	3	0	15	15⅙	— 0	1	7	— ⅙	0
No. 2.—10 *inch Mortar.*																	
600⅔ Yards..............	1	3	15	1	4	8	2	1	2	0	10½	10½	— 0	0	9	0	+ ·1
815 „	1	7	10	1	9	4	2	4	2	5	$12\frac{3}{12}$	$12\frac{5}{12}$	— 0	1	10	— ⅙	— ·1
1010 „	1	12	3	1	14	0	2	7	2	8	13½	$14\frac{1}{12}$	— 0	1	13	— $\frac{7}{12}$	— ·1
1150⅓ „	1	15	7	2	1	0	2	9	3	0	$14\frac{6}{12}$	$14\frac{11}{12}$	— 0	1	9	— $\frac{5}{12}$	— ·1
1204 „	2	0	15	2	2	6	3	0	3	0	15	$15\frac{3}{12}$	— 0	1	7	— ¼	0

No. 1.—8 inch Mortar.																				
570 Yards	0	12	3	0	12	13	2	1	2	1	$10\frac{1}{4}$	$10\frac{1}{3}$	—	0	0	10	—	$\frac{1}{12}$		0
614 "	0	12	12	0	13	4	2	1	2	0	$10\frac{3}{4}$	11	—	0	0	8	—	$\frac{1}{4}$	+	·1
824 "	0	15	3	1	0	0	2	5	2	5	$12\frac{1}{4}$	$12\frac{5}{12}$	—	0	0	13	—	$\frac{1}{6}$		0
785 "	0	14	13	0	15	12	2	4	2	5	13	$12\frac{1}{4}$	—	0	0	15	+	$\frac{3}{4}$	—	·1
1003 "	1	1	10	1	3	0	2	7	2	8	$13\frac{1}{5}$	$14\frac{1}{4}$	—	0	1	6	—	$\frac{3}{4}$	—	·1
1177 "	1	4	9	1	5	8	2	9	3	0	$14\frac{3}{4}$	$15\frac{1}{4}$	—	0	0	15	—	$\frac{1}{2}$	—	·1
No. 2.—8 inch Mortar.																				
$612\frac{1}{3}$ Yards	0	12	12	0	13	0	2	1	2	0	$10\frac{1}{2}$	$10\frac{2}{3}$	—	0	0	4	—	$\frac{1}{6}$	+	·1
$803\frac{2}{3}$ "	0	15	0	1	0	0	2	4	2	5	$12\frac{1}{4}$	$12\frac{5}{12}$	—	0	1	0	—	$\frac{1}{6}$	—	·1
$1032\frac{2}{3}$ "	1	2	2	1	3	8	2	7	2	8	$13\frac{5}{6}$	$14\frac{1}{6}$	—	0	1	6	—	$\frac{1}{3}$	—	·1
1185 "	1	4	12	1	5	8	2	9	3	0	$14\frac{4}{6}$	$15\frac{1}{4}$	—	0	0	12	—	$\frac{5}{12}$	—	·1
No. 4.—8 inch Mortar.																				
581 Yards	0	12	6	0	13	4	2	0	2	0	$10\frac{1}{4}$	$10\frac{1}{2}$	—	0	0	14	—	$\frac{1}{4}$		0
816 "	0	15	2	1	0	0	2	4	2	5	$12\frac{1}{4}$	$12\frac{5}{12}$	—	0	0	14	—	$\frac{1}{6}$	—	·1
1011 "	1	1	13	1	3	8	2	7	2	8	$13\frac{1}{3}$	$14\frac{1}{6}$	—	0	1	11	—	$\frac{2}{3}$	—	·1
1178 "	1	4	10	1	5	0	2	9	3	0	$14\frac{3}{4}$	15	—	0	0	6	—	$\frac{1}{4}$	—	·1

Captain Smith's Instrument was submitted to the Artillery Select Committee in November 1836, when they remarked as follows:—

The Committee can entertain but one opinion as to the ingenuity and talent displayed by Captain Smith in the construction of the Gunner's slide.

2d. It is seldom however, that the Practical Artillerist can have occasion to refer to such instruments, and let them be ever so well contrived, they cannot with any prospect of permanent advantage be issued to the Service for general practical purposes, for, in the most scientifically constructed instrument, it is impossible to guard against the discrepancies, caused by the variations in the dimensions of Ordnance and Projectiles and deteriorations which take place in gunpowder.

3d. Captain Smith's slide works remarkably well, yet, when necessary to consult authority, glancing the eye over Practice Tables, ready drawn out, would be infinitely easier, than working out the question on the slide.

4th. Written tables can be corrected, renewed, and placed in the Gunners hands at a trifling expense, whilst instruments are not only expensive, but once arranged, cannot be altered.

5th. The slide as at present constructed, will only serve for mortars, whilst the practice tables now in use, are constructed for all kinds of Ordnance.

6th. Captain Smith seems to think, he can supply any want, or remedy any defects in the present instrument: so much ability has been shewn in the arrangement of the present one, as far as it goes, that the Committee would gladly see that Officer entrusted with its modification.

7th. If it should be thought advisable, to introduce such instruments into the Service, the Committee would recommend an increase in the size, for it is with much difficulty that the numbers and some of the lines of demarcation can be read off on the present slide, and it should be made of metal, as ivory or wood is apt to warp in hot weather.

8th. The tables should be constructed for iron mortars, brass ones having become obsolete.

9th. In the present ivory slide, there is a mistake, copied from the tables in the Madras Gunner—viz. in the charges with powder of 1200 and 1400 yards proof, the largest charge for the 13 inch, is given to the strongest powder from 500 yards upwards.

HEAVY GUNS.

In Garrisons, iron guns are used to keep an enemy at a distance and destroy his approaches.

In the Field, to demolish embrazures, parapets, or any obstruction that may be in the way of the advance of the troops, to enfilade an enemy's works, destroy his defences or breach his walls.

Coast batteries armed with heavy guns are intended to keep off shipping or to prevent the landing of troops.

To effect these purposes we have the ricochet, enfilading and direct fire.

Enfilade Fire à Ricochet.

The enfilade fire à ricochet was generally considered applicable to all distances and to be of itself infallible.

This colossal reputation was in all probability first acquired by enfilade fire, from being powerfully and judiciously employed, whilst it surprised by its novelty, and before means could be devised to ward off its effects.

No shot fired with only a few ounces of powder can possibly have sufficient force to penetrate through or break down a moderate obstacle, and consequently a ricochet shot cannot injure guns or troops which are well and closely covered by traverses.

Previously to the sieges in Spain this nature of fire had been utterly neglected in England.

Its character was taken on trust from the continental powers, who finding the reduced charge, most applicable to their brass guns, had an interested motive for vaunting forth its praise.

In 1820 and 1821 a course of practice was carried on at Woolwich under Colonels Sir A. Fraser and Dickson of the Royal Artillery, and from it was assumed that about 400 yards is the best distance for an enfilade à ricochet. That such fire is to be preferred to any other with the distance of 600 yards from the object, but that beyond 600 yards fully ⅗ of the ammunition will be thrown away, and consequently ricochet firing can rarely be an advantageous employment of Artillery when precision is required at any distance exceeding 600 or 650 yards.

In the defence however when directed against the approaches, and parallels of a besieger, spread over an immense space, this nature of fire from its bounding and grazing, must at all periods of a siege prove of great annoyance to working parties and guard of the trenches.

Ricochet fire, would appear from the experiments, to enjoy a reputation in the attack of places beyond its merit, and most probably from the circumstance that in all regular and well conducted sieges, the enfilade batteries à ricochet are invariably seconded by a powerful fire of mortars on the faces or flanks of works, the Artillery of which these are intended to silence and the end being obtained, a degree of credit is given to the fashionable and favorite fire à ricochet, which ought in justice to be largely shared with the mortars, for the late experiments justify the belief that without the assistance of heavy vertical fire, an enfilade fire à ricochet, cannot be rendered destructive along a face well traversed.

Where means are limited and it is essential to success to make the most effectual and judicious use of the weapons and ammunition brought up, heavy gun batteries to fire à ricochet should be prohibited.

Enfilade Fire with full Charges.

Experience has proved that an enfilade fire with the full charges of powder may be rendered extremely annoying to extensive and general lines of defensive works and will sweep along them, making many bounds from distances as great as 1800 yards.

Against single lines such as a face or a flank, a shot fired from a distance to require the full charge, has little chance of striking the *terre plein* with precision, and no chance of making a second bound when the work is properly traversed. Indeed it is probable that its force would be generally on the traverses, which shells would far more powerfully destroy, beside which spherical case fired from 24-pounders at any distance exceeding, 600 or 700 yards to enfilade a moderate line, would be infinitely more destructive to the defenders than round shot.

Shells are absolutely necessary as Pioneers to level the projecting parapet.

Breaching.

The best method of forming a breach, is first to cut the revetment towards the bottom when the ditch is dry ; and level with the water when the ditch is full, by an horizontal line, and at various distances by vertical lines ; to shake afterwards each portion of the walls, between two of the vertical lines, to cause it to crumble into the ditch, these cuttings will the easier be made, when the shot has great velocity, because it only requires to produce this effect, to bury the shot in the masonry, without its being requisite to shake the contiguous parts, for this a velocity of 1400, 1500 and 1600 feet will be sufficient. The destruction of the revetment being thus prepared, it is only necessary to break the mass between the vertical lines—to shake these parts, disunite them, and then the principal object must be the tumbling to pieces, which will soon take place. The weight of the materials and the spreading of the earth, will contribute nearly as much to this, as the repeated shocks of the shot, which in such a case should not have the same velocity as when making the cuttings, they should not bury themselves in the masonry but shake it, and it will be sufficient for this, that motion be communicated to the surrounding parts by shocks alone, charges which will give the shot a velocity of 1000 or 1200 feet, will answer perfectly well for this, each gun in the breaching battery should fire the whole breadth of its embrazure, and endeavour to unite the cuttings of those next to it, the two outer guns must direct their fire inwards, the revetment once opened, salvos or vollies must be fired.

To make a breach at 60 paces, experiment has proved, that 500 rounds per gun, is sufficient ; with 24-pounders a breach may be opened at 900 paces, but the guns must be renewed, and 3 or 4 times the quantity of ammunition will be necessary.

Batteries to breach, fire as quickly as they can with precision, about 25 or 30 rounds per hour, but as this rate of firing is likely to injure the guns, and will not be kept up when opposed by musketry, the average proportion may be stated at 20 rounds.

At the siege of St. Sebastian 3500 rounds were fired from 10 guns in 5½ hours, great accuracy of range being at the same time observed. It was at this siege where the British Artillery, shewed so much skill in firing over the heads of their troops. The Artillery from 5 days continued firing, knew the range precisely, and the practice against the high curtain was admirable; for although the shot passed immediately over the troops, on the face and foot of the breach, and swept away the defenders of the curtain it occasioned no casualties among the assailants.

This tremenduous fire, although only maintained for 20 minutes, had dismounted every gun but two, many of the guns had their muzzles shot away.

An exposed wall may be breached with certainty at distances from 500 to 700 yards, even when elevated 100 feet above the breaching battery, and it is believed that in a case of extreme necessity, it would be justifiable, to attempt to batter down an exposed wall, from any distance not exceeding 1000 yards, but then the quantity of Artillery must be considerable, and it will require from four to seven days firing, according to the number of guns in battery, and the period of day-light to render a breach practicable.

In forming a breach at such distances, it is absolutely necessary to commence battering the wall at its very foot, for this distant fire does not admit of such precision, and the whole face of the wall intended to be brought down, is struck throughout pretty equally at every round fired from the battery, consequently the wall is never cut through in regular lines, as when battered from a distance of 50 or 60 yards, and brought down bodily, but the breach is formed by the bricks or stones, which fall successively, therefore if the fire be not at first directed very low, the rubbish from the upper part quickly accumulates in front of the lower part of the wall, and it becomes covered and sheltered from the effect of the shot before it has received any considerable injury, in which case the total quantity of stone, earth, and clay brought down, seldom suffices to make a good road over the portion of the wall, left standing untouched, which in some breaches will be found to exceed, 12 feet in height; many shot will of course, in the endeavour to fire low down, strike the ditch, and be thrown away, from want of elevation, but such loss is not to be put in comparison with the greater chance it affords of forming an easy breach.

In forming breaches from such great distances, the fire of the batteries should be suspended during the night, but as the Garrison frequently attempt to clear away the rubbish, and often with considerable success, it is very desirable, that a constant discharge of grape or canister shot should be kept up on the breach during the cessation from battering, and a liberal provision should invariably be made for that service in the proportion of ammunition brought up at every siege.

At the late siege of Antwerp in 1832, a breach was formed from 6 twenty pounders brass, at a distance of 52 yards, and the following instructions were given by the French Commandant of Artillery.

Effect to be produced.

The revetment must be cut at the bottom horizontally, level with the water, the whole length of the breach. In order to ensure this, each gun must connect the cut made by those on its right and left, by ranging the whole breadth of the embrazure. The outer guns to direct their fire first inwards ; above this horizontal line, vertical ones will be cut at equal distances as high as the cordon. To effect this, each gun must fire right before it ; salvos afterwards must be used to shake the wall between each division, to cause its fall into the ditch, always firing from bottom to top.

Charges.

At first a few rounds are to be fired with 8lbs. so as gradually to heat the gun, afterwards the charges must be regulated according to the effect produced.

Twelve-pounds of powder are required to commence cutting the revetment ; to complete the breach 6½ to 4-pounds.

Mode of Loading.

The preservation of the guns requires that wooden bottoms and wads should be used, attention must be paid to have the wads of different lengths, and that they are so used, as frequently to alter the seat of the shot, in order to delay the rapid enlargement of the bore as much as possible.

Pointing.

In consequence of the proximity of the object, each gun should be pointed two feet above the spot it is wished to strike.

This battery fired for 17½ hours,—viz. 6 hours the first day,—9 hours the second, and 2½ the third day, 1197 round shot were fired, 300 with a charge of 12lbs. and the remainder with that of 8lbs.

Table of Iron Guns.

Nature of Guns.	Calibre	Length of				Weight.			Proportion between gun and shot.
		Gun.		Bore.					
	inches.	feet.	inches.	feet.	inches.	cwt.	qrs.	lbs.	
24-Pounder.	5.823	9	0	8	5.45	47	2	8	224
18 „	5.292	9	0	8	5.75	42	0	12	262
12 „	4.623	9	0	8	6.23	33	3	24	317

Table of Powder allowed for various purposes with Iron Guns.

Nature of Guns.	Proof of		Service charge at						Scaling.	Saluting.
	Gun.	Carriage.	1000 yds. proof.		1200 yds. proof.		1400 yds. proof.			
	lbs.	lbs.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	lbs.
24-Pounder..	18	8	8	0	6	11	6	7	2	6
18 „	15	6	6	0	5	0	4	13	1½	4½
12 „	12	4	4	0	3	6	3	4	¾	3

Table of Shot for Iron Guns.

Nature of Guns.	Round.				Canister			Spherical Case.				
	Diameter.											
	Maximum.	Minimum.	Weight.		No. of balls.	Weight.		Musket balls.	Bursting Powder.		Weight.	
	ins.	ins.	lbs.	oz.	No.	lbs.	oz.	No.	oz.	drs.	lbs.	oz.
24-Pounder.	5.639	5.584	23	8	90	18	4	130	6	0	20	0
18 ,,	5.124	5.074	17	8	85	18	2	90	5	0	14	12
12 ,,	4.476	4.432	11	11	84	12	8	63	4	8	10	2

The number of men for the Service of Iron Guns in Batteries, is as follows.

24 Pounder............6 men
18 ,, ...5 ,,
12 ,, ... 4 ,,

The following is their disposition and duties.

24-*Pounder Gun.*

No. 1. Guides the gun into the line of fire with a handspike, points and commands.
No. 2. Spunges, runs up and elevates.
No. 3. Loads, runs up and elevates.
No. 4. Serves the vent, runs up, traverses and primes.
No. 5. Runs up, traverses and fires.
No. 6. Brings cartridges, and serves 3 with shot and wads.

18-*Pounder Gun.*

No. 1. Guides the gun into the line of fire with a handspike, points and commands.
No. 2. Spunges, runs up and elevates.
No. 3. Loads, runs up and elevates.
No. 4. Serves the vent, runs up, traverses and primes.
No. 5. Brings cartridges, serves 3 with shot and wads, runs up, traverses and fires.

12-*Pounder Gun.*

No. 1. Serves the vent, runs up, points, primes, and commands.
No. 2. Spunges, runs up, elevates and traverses.
No. 3. Loads, runs up, elevates and traverses.
No. 4. Brings cartridges, serves 3 with shot and wads, runs up and fires.

Besides the men told off to the gun, there must be some at the magazine, to fill and issue cartridges ; when spherical case or shells are fired, some men must be appointed for filling them, and for cutting and fixing fuzes ; the man who brings up the cartridge, is also to bring up the shell or spherical case, 3 uncaps the fuze.

The following Stores are required for the service of heavy ordnance in batteries.

One spunge.

One wad hook and ladle—to be placed on the right of the gun, outside of 2, resting against the parapet, the spunge head and the wad hook uppermost.

Four handspikes—two on each side of the platform close to the edge of it, points towards the parapet ; the points of the front handspikes about two feet from the hurter, the points of the rear ones should overlap inside to about the middle of the front ones. All bevelled handspikes are to be laid down bevelled side upwards. With garrison carriages a fifth handspike is required, and is placed close to the rear of the middle of the platform, small end to the right.

One linstock.

One portfire stick and portfire, are placed near the parapet on the left side of the gun.

Shot—piled on the left of the gun close to the front of the platform.

Wads—if necessary close to the shot.

One priming pouch, slung over the left shoulder of No. 4.

One pricker } in the loops of the priming pouch.
One bitt steel }

One water bucket in charge of No. 5, behind him, and close to the parapet.

When heavy guns are in position, and there is no parapet, the side arms are laid on the ground in the same order as before, about two paces from the gun and parallel to it.

Method of placing Guns in Battery.

The guns in a battery are placed on platforms 18 feet asunder,—the shot and wads piled on the left of them.

Rules to be observed in laying and loading Guns.

1st. The Non-Commissioned Officers told off to each gun, takes the centres at the breech and muzzle with the perpendicular, and marks the line of direction with chalk.

This however is not required where the centres have been previously cut in the metal, for although they may not be quite correct with reference to the level of the platform, any error will be quickly rectified after a round or two.

2d. The gun is run back and loaded, the cartridge first, then a shot and a wad over the shot; formerly two wads were used, one over the powder, and one over the shot. In sending home the cartridge, care must be had, that the seam is not placed under the vent.

3d. The gun is then run up and laid for the object, this must be carefully done by bringing the centres in line with the object, and is effected by throwing the trail to the right or left according to circumstances.

4th. The elevation is next given—this, when there is an elevating screw is done with quickness and precision; with quoins the work is slower; in both cases, the quadrant is seldom required, and the eye will generally be sufficiently correct.

5th. The gun is next primed with loose powder, tubes being seldom or ever used. The cartridge is first perforated with the pricker, the vent is filled with powder, and some of it laid for an inch and half in front, the powder is then bruised in order that it may inflame more readily when in contact with the match or portfire. If the gun is not immediately fired, the priming should be covered with an apron until the word " fire" is given.

6th. In firing, the match or portfire must be held, so as to touch the front of the priming, in order to be as far as possible from the explosion.

7th. Portfires are dangerous in a battery, and heavy guns are seldom fired with such rapidity, as to require them.

8th. With iron guns, it is a good precaution to commence with low charges, so as gradually to warm the piece.

9th. In long firing, wads of various lengths should be used, to avoid as much as possible making a lodgment in the bore, by placing the shot on the same spot.

10th. Scaling is not necessary after the first day's firing.

11th. After scaling, great attention should be paid to the proper spunging, as from the smallness of the charge pieces of the cartridge bag frequently remain in the bore and if the gun is immediately re-loaded without careful spunging accidents may occur.

Rules for calculating Charges.

For the purposes of calculating the quantity of gunpowder requisite for certain equipments, or the means necessary for its transport, the charges are the same for all description of ammunition, viz. one-third the weight of the round shot.

This, as a general rule, for the simplification of equipments, is no doubt good, but much should be left to the discernment of an Officer, who must be guided by the object he has in view, and the strength of his powder.

Too heavy a charge is objectionable, as it even diminishes the amount of effect, because :

1st. Being long, it shortens the length of the bore in front of the shot.

2d. The first portion of the powder which ignites, forces before it, not only the shot, but that part also of the powder yet unignited.

3d. The elastic fluid being very great, gets round the shot through the windage, re-acts to the rear, and tends to repulse it in a contrary way, so much the more violently, as the windage is greater.

4th. Too large charges are mostly consumed outside the bore, and without effect, as is shown by the unignited powder which falls to the ground.

Theoretically, the best charge for a given piece of ordnance and its projectile, is that which is found entirely consumed at the moment the projectile reaches the muzzle—for then there is a minimum of powder used, for no part is uselessly consumed outside the piece, and there is a maximum of velocity, produced by the successive combustion in the whole extent of the bore.

It would be difficult however to fix the exact charge, so as to obtain such a result.

The best rules are:

1st. The initial velocity of a projectile increases with the charge of powder to a certain extent, beyond which (for the same piece) an increase of charge gives a diminution of velocity.

2d. With the same charge, the velocity encreases, as the length of the gun is greater. The ratio of this increase is between the square and cube root of the length.

3d. The ranges increase only as the square root of the velocities, in consequence of the resistance of the air, which retards the more as the velocity increases.

4th. For the same charge, the ranges increase only as the fifth root of the length of the piece: for instance, with double the length, the range is only increased one-seventh.

5th. The smallest diminution of windage produces with the same charge a great increase of velocity.

6th. The increase of charge beyond a certain point, which reaches scarcely beyond one-third the weight of the projectile, gives but a small increase of range.

7th. The most servicable charge, is proportionally greater for small calibres than for large ones, it should therefore be diminished as the calibre increases.

8th. The weight of the servicable charge should be lessened as the length of the piece diminishes, and also when the projectile being hollow, becomes specifically lighter: since both of these circumstances lessens the quantity of powder which can be entirely consumed before the projectile quits the piece. General Scharnhorst made some very extensive experiments on the influence of the charge on the range. The guns used were 12 and 3-pounders, eighteen calibres in length and fired with round shot, with an elevation from 1 to 4 degrees, and with charges of $\frac{2}{12}$, $\frac{3}{12}$, $\frac{4}{12}$, $\frac{5}{12}$, $\frac{6}{12}$, the weight of the shot.

The ranges of the first graze were as the numbers 19, 22, 23, 26, 27, thus the double charge only increased the range in the proportion of 19 to 23, and the treble charge in that of 19 to 27 for this kind of ordnance.

Other experiments made at Strasburgh proved that with a 6 pounder the charges successively increased from one-fourth to one third and from one-third to one-half the weight of the projectile, gave but small increase of range.

In 1740, a 24-pounder was tried with an elevation of 4 degrees with successive charges of 8, 9, 10, 11, 12, 14, 16, 18 and 20lbs. of powder, and the ranges, the mediums of 4 rounds were 800, 828, 850, 866, 833, 844, 949, 975 and 970 yards.

On the conclusion of the last Mahratta War, the late Lieutenant Colonel Dalrymple, C. B. who commanded the Artillery with Sir Thomas Munro's and General Pritzler's Divisions in the Doab, where they had a great deal of breaching duty, stated the Madras powder has been
" brought to a state of great strength and perfection since
" my arrival in India, so much so, that I observed 4½lbs. of
" the present powder, fully equal to 6lbs. of the former pow-
" der for all purposes of common service.

" Iron guns at several sieges during the last war, were
" perfectly destroyed in their vents, by using what is consi-
" dered the established charge both in this country and in
" Europe, viz. one-third of the weight of the shot, or 6lbs. for
" an 18-pounder, and 4lbs. for a 12-pounder, and this I could
" only ascribe to the extraordinary strength and good quality
" of the powder.

" Being aware of this circumstance I directed a reduction in
" the charge for battery service with the Artillery under my
" command, using for iron 18 pounders 4½ instead of 6lbs. of
" powder, and for 12-pounders 3 instead of 4lbs. and found it
" a most sufficient charge for all the purposes of a siege."

HOT SHOT.

Hot shot is much used in firing from coast batteries against shipping: at the siege of Gibralter, the floating batteries of the Spaniards were destroyed by it.

Method of Heating Shot.

Various kinds of furnaces have been tried, but the most complete is a wall, fig. 33, through which the nose of a large forge bellows is made to pass, with an iron grate on the opposite side, raised about a foot and a half or two feet, the grate projects from the brick wall, and is composed of cross bars so as to admit of shot of different sizes resting on them without passing through, they are then covered with bratties and firewood. After the grate is once heated, which takes from 30 to 45 minutes, shot will be brought to a red heat in about 15 or 20 minutes.

It has been ascertained by experience, that shot ought to be heated to a degree a little below ignition or the red heat.

If the heat be less, the object struck will not be set on fire, if it be more, the shot will not fit the gun so well, on account of its expansion, and the service will be impeded by the speedy heating of the gun itself, or the shot is liable to split on striking a hard substance.

Portable Furnace.

There is also a portable furnace, fig. 34, but which has been objected to on the following grounds:—

1st.—In the vicinity of the grate, the combustion is so rapid and intense as to burn, scale, and even melt the shot.

2d.—These heated shot cannot be taken out without removing the others which lie upon them.

3d.—If those can be duly heated, the others below them will necessarily have been exposed to all the consequences of a fire too intense, and if not rendered unfit for service, they will at all events be so hot as to require a long time to cool; on the other hand, if the excess of heat in the lower part of the furnace be avoided, the upper ranges of shot must be taken out, while yet unfit for service, and suffer a degree of exposure which must retard their subsequent heating, to the detriment of the service, and waste of time and fuel. In addition to all these most serious inconveniences, the necessary and speedy destruction of the furnace must be taken into account.

The bars or grate of this structure from their vicinity to the most active portion of the fire, must undergo a considerable degree of heat, and since nearly the whole weight of the shot and fuel rests upon them, they are liable to be bent and destroyed in a short time.

Should there be no furnace at hand, shot can always be heated by digging a hole in the ground and screening it from the wind.

The charges for hot shot should not be greater than 1-6th or 1-5th weight of shot.

Directions to be observed in firing with Red Hot Shot.

1st.—Officers in charge of guns, are carefully to examine the cartridge bags, that they are sufficiently close in their texture as not to admit any powder working through, cartridges of strong flannel are best for this use.

2d.—The cartridges to be sent home gently with the rammer head, or for greater ~~society~~ security with the spunge head, which will bring out any particles of powder; upon the cartridge a high dry junk wad, with one blow, upon this a high soaked wad with two blows.

3d.—The hot shot being cleared of dust or dirt and gauged, brought on the carrier, is to be put in the gun, the man at the carrier end furthest from the grate, letting go his handle as soon as the shot has entered the gun, that his fellow carrier may take it to the grate or furnace, to be ready to bring fresh shot.

4th.—The gun being elevated one degree, will allow of the shot rolling home, a low soaked junk wad to be set home over the shot.

The foregoing precautions being strictly attended to, and which must be the duty of every Officer and Non-Commissioned Officer in charge of guns, to cause being observed, the gun may be run up, pointed, and elevated with as little danger as with cold shot.

Wads should be well soaked and the water well squeezed out, that a drop of water will not come from them.

NIGHT FIRING.

Night firing when necessary, is generally limited to a few rounds at intervals, for the purpose of general annoyance, and to disturb working parties, also to prevent repairs being made to breaches.

Grape shot is frequently fired during the night—the following precautions must be taken.

The gun having been properly laid during the day, a bead, or piece of timber of a proper scantling must be nailed or screwed to the platform, inside the felloe of each wheel, and parallel to the object line, and two shorter pieces fastened in like manner outside of the cheeks of the carriage at the trail, or if using a traversing platform on the rear sleeper, so as to secure the trail plank.

A lanthorn will be required in order to adjust the elevation; another method is to chalk the carriage and platform in different places, and when the gun is run up after firing, these marks should be made to correspond.

RANGES WITH HEAVY GUNS, ROUND SHOT.

Elevation.	Range.	Elevation.	Range.	Elevation.	Range.
P. B.	400	2¼	1250	4½	1700
¼	500	2½	1300	5	1800
½	600	2¾	1350	5½	1890
¾	700	3	1400	6	1980
1	800	3¼	1450	6½	2064
1¼	900	3½	1500	7	2148
1½	1000	3¾	1550	15	3500
1¾	1100	4	1600		
2	1200				

RICOCHET PRACTICE.

Distances.	24-Pounders.			18-Pounders.			12-Pounders.		
	Charge.		Elevation.	Charge.		Elevation.	Charge.		Elevation.
	lbs.	oz.	deg.	lbs.	oz.	deg.	lbs.	oz.	deg.
400	0	12	6¼	0	10	4	0	8	4½
400	0	10	7¾	0	9	6½	0	6	6½
400	0	8	11	0	6	8	0	0	0
600	1	8	4	1	2	5	0	12	4¾
600	1	4	5	1	0	5¼	0	10	6
600	1	0	6¼	0	12	7¼	0	8	7¾
800	2	0	3¾	1	12	3	1	4	3
800	1	8	5½	1	8	4¼	1	0	4½
800	1	0	8½	1	0	7	0	12	6½

Common shells for ricochétting with small charges, may be used from the 24 and 12-pounders. The 5½-inch and 4⅖ shell will answer for them; there are no shells excepting spherical case, cast for 18 pounders.

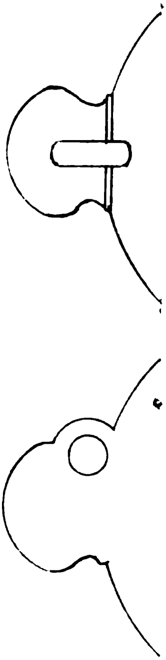
In consequence of the very small charges used in ricochet fire, care must be taken to spunge the gun well out after each round, for the same reason that it is enjoined after scaling.

SPHERICAL CASE SHOT.

Distances.	24-Pounders.		18-Pounders.		12-Pounders.	
	Elevation.	Fuze.	Elevation.	Fuze.	Elevation.	Fuze.
	deg.	inches.	deg.	inches.	deg.	inches.
650	1¼	.2	1¼	.2	1¼	.2
900	1¾	.35	2	.4	1¾	.4
1000	2½	.5	3	.575	2½	.595

CANISTER SHOT.

Canister shot is seldom used from heavy guns, excepting in repelling an attempt to storm the batteries, or in firing into breaches, to prevent their being repaired.



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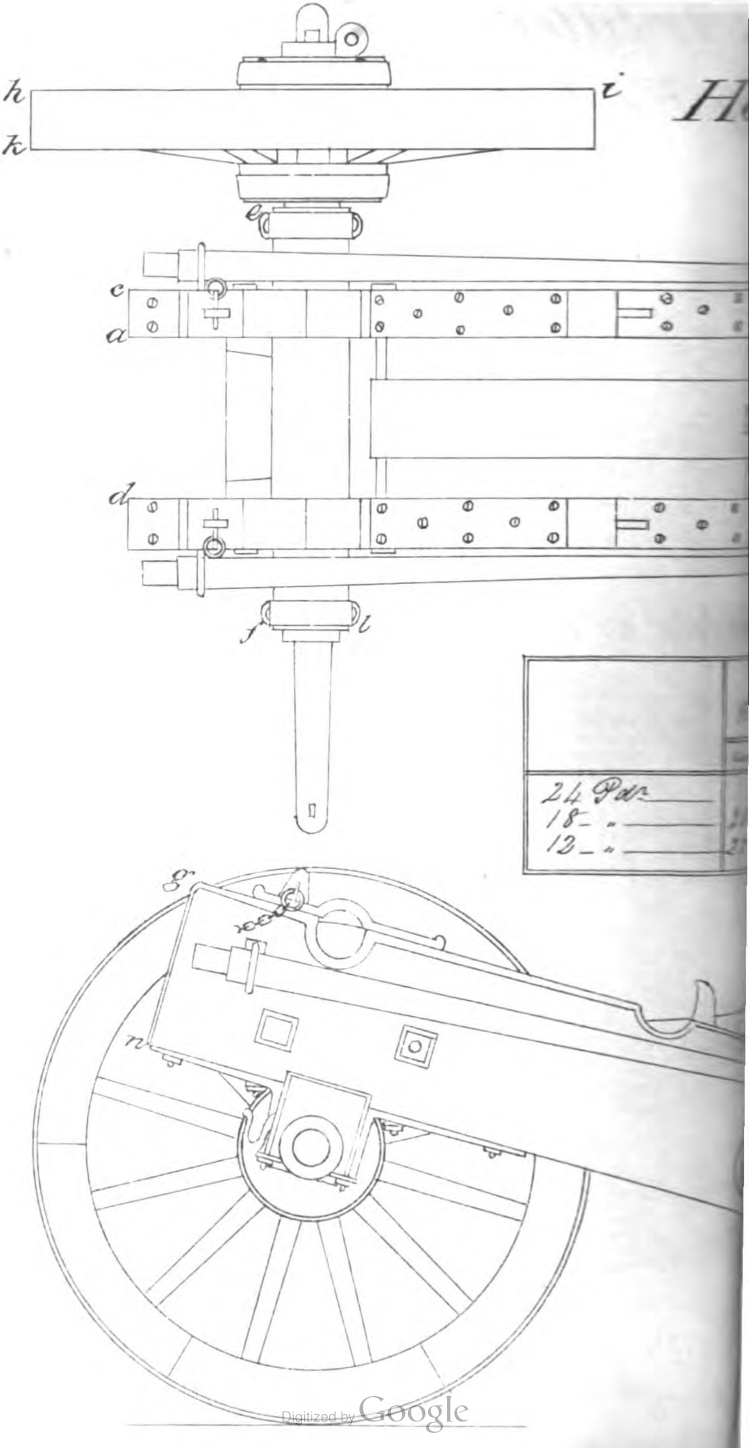
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Artillery.

ry Field Carriages.

fig 30.

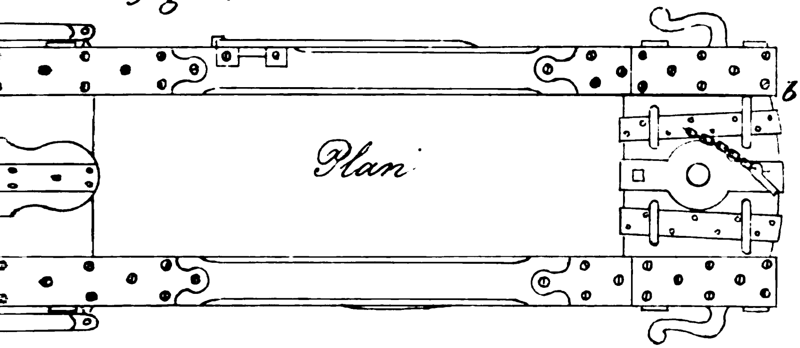
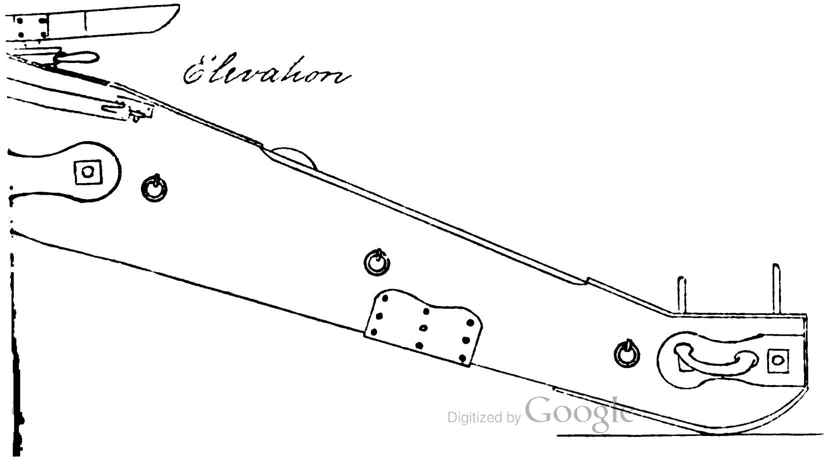


Table of Dimensions.

ght		Length from															
		a to b		a to c		a to d		g to n		c to f		f to l		h to i		h to k	
	ths	ins	ths	ins	ths	in	ths	in	ths	ins	ths	ins	ths	ins	ths	ins	ths
	4	147	4	4	8	16	2	17	5	44	.	8	5	4	9	6	.
	1	135	.	4	5	14	6	15	2	44	.	8	5	4	9	6	



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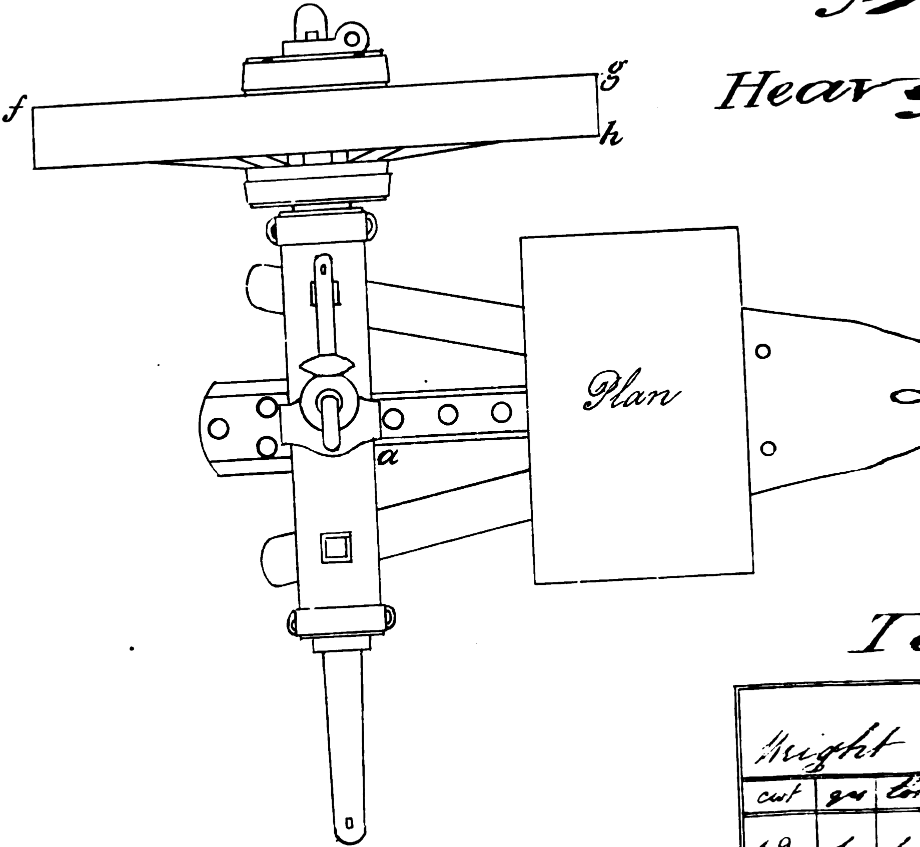

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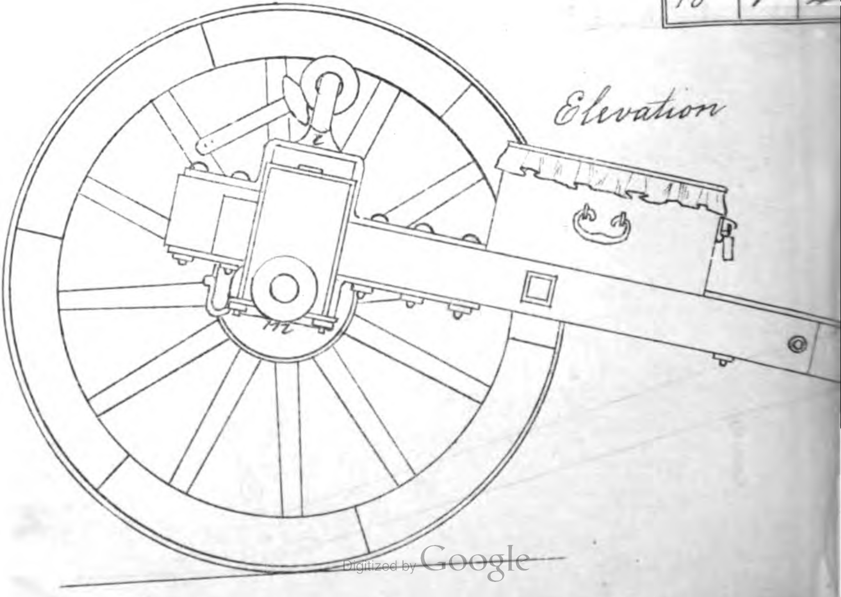
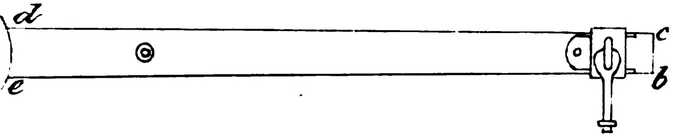
Weight		
cwt	qrs	lb
18	1	4



rtillery.

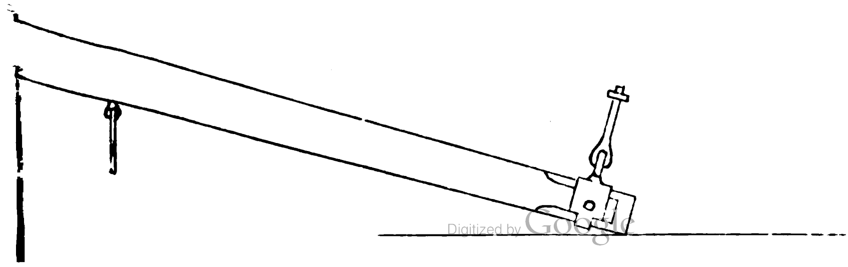
Field Limber.

fig 31.



able of Dimensions.

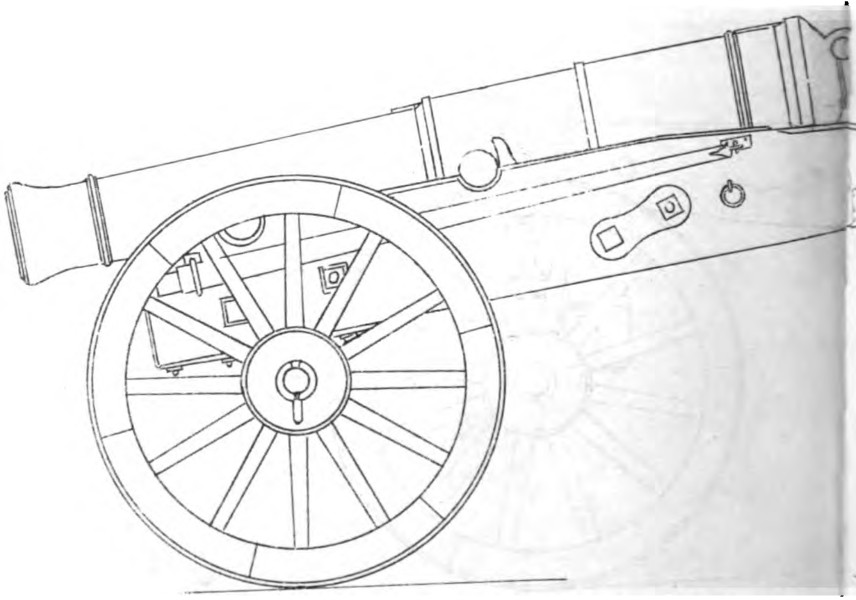
Length from				Diameter at							
a to b		i to m		d e		c b		f g		g h	
ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths
135	.	19	.	5	7	4	5	4	9	6	.



Artill

Iron Gun M

fig 32.



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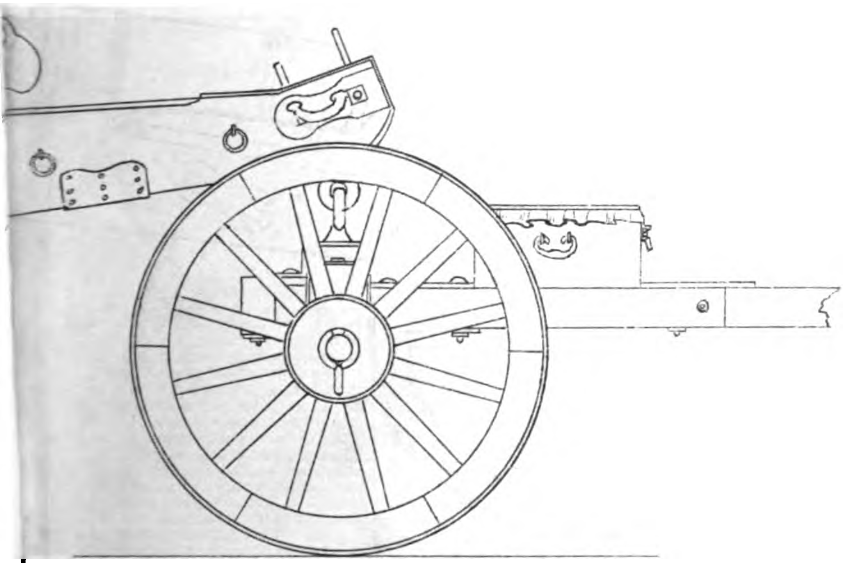
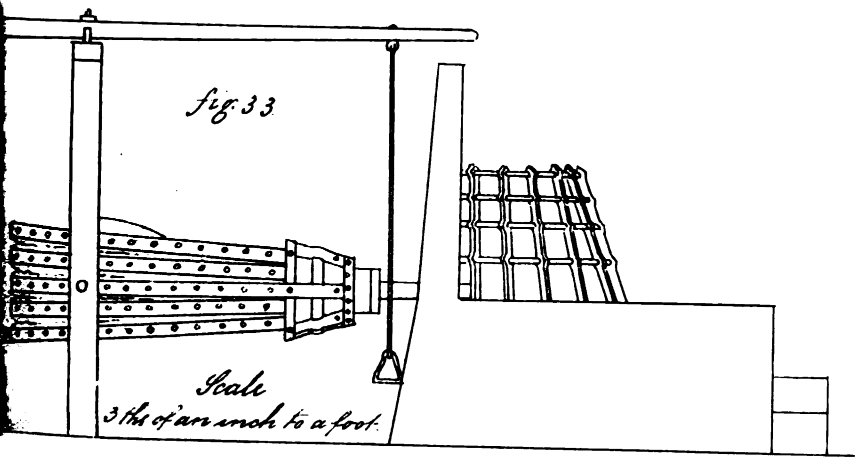


Artillery

Furnaces Hot Shot.

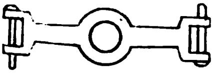
Permanent.

fig. 33

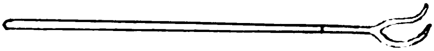


Scale
3ths of an inch to a foot.

Carrier



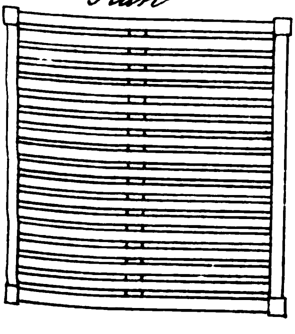
Fork



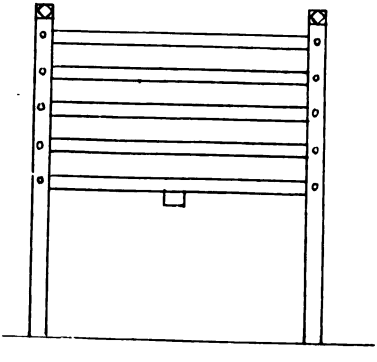
Field.

fig. 34.

Plan



Elevation



Scale 3/4 of an inch to a foot.

LIGHT GUNS AND HOWITZERS.

Field guns take so prominent a part in all engagements that the best mode of using them should form an important part in the study of every Officer.

An Officer ignorant of his duty will commit numberless blunders which the enemy will turn to advantage.

It may so happen that he will cease firing, and leave his position when he should not, he will be unable to open his fire until too late, he will uselessly expend his ammunition producing no other effects than loud reports, and find himself short of ammunition when most needed.

To shew how to avoid these errors a few remarks may not be out of place; it is impossible, however, to lay down rules for all the cases which may occur on service, for much must depend on the nature of the War, the country engaged in, and the views of the Commander of the Forces.

Hilly and swampy countries, or those intersected by ravines, will always retard the advance of the Artillery, principally if moving in large batteries.

When approaching an enemy every thing should be in readiness, matches lighted, small stores distributed, and every man at his post of exercise, elevating screw so arranged as to leave the piece in a horizontal position when unlimbered. The Traces and Harness or Gear well examined, water buckets filled and padlocks removed from limber and ammunition boxes.

The battery advances as the ground will permit, either in column or line generally. Infantry attack an enemy in column, Cavalry in line, Artillery in column by divisions when it is intended to deceive the enemy, or conceal the number of guns.

When in pursuit of an enemy one battery advances while the other fires.

The Artillery commences the action at a distance; it is able to act when other arms are powerless, it must protect the deployment of an Army and support the wings when not covered by natural obstacles. It saves the Troops by drawing on itself the fire of the enemy; it destroys all temporary obstructions thrown up by the enemy to retard the march of the army, finally it secures victory by concentrating its fire on the most important point of attack, or protects retreat by restraining and keeping the enemy in check.

Commence the action with the heaviest calibres and with only a portion of guns, do not fire at first on the point intended to be attacked, so as to deceive the enemy, when the critical moment has arrived concentrate all the fire on one point and not cannonade the whole line—do not offer a flank to the enemy's Artillery, unless by it, prompt and decisive effect may be produced.

Endeavour to take the enemy in flank—if this is of no great extent, take up in preference a slanting position which will admit of firing on the Troops at an angle of about 20 degrees, as you advance, this angle must gradually disappear.

The principal object of Artillery in action is the enemy's Troops, and never their Artillery, unless the Troops are sheltered and your own suffer from their guns. Seldom will the destruction of one battery cause the retreat of the other Troops, whilst the retreat of the attacking columns will necessarily involve that of the Artillery. If obliged to fire on the enemy's Artillery take them in flank—fire with rapidity whenever they unlimber or limber up, and endeavour to dismount them with your guns, while the howitzers continue to play on the Troops.

Rapidity of firing should however be regulated by the certainty of execution.

At great distances study to point with care, rather than to fire quickly.

To avoid useless firing, observe well the effect of each round when firing at long ranges.

In order to observe your fire, whenever practicable open your battery to leeward, and place yourself to windward, as the engagement becomes more serious, your fire should be more animated; when within good range of canister shot, there is no longer any laying of guns, fire at point-blank attending only to true direction, and at *critical moments* the fire may be quickened by spunging only every third or fourth round.

Round shot is more destructive than canister, and the latter should only be used at shorter distances. Do not change your elevation or direction immediately after each round, but where several rounds have carried too much to the right or left, fallen short of or beyond the object, either direction or elevation must be rectified.

If you have two guns fire alternately, so that when one is fired the other is being loaded; when superior to the enemy in number of guns fire several together.

The fire of batteries of position should be kept up with the greatest steadiness and regularity, the time between each round should be regular so as to keep up a steady fire; it is imprudent to fire a number of rounds and then cease firing for a time.

Should the enemy's Cavalry be at the distance of 1000 yards from the Infantry which it is to charge, it will move over the first 400 yards at a walk approaching to a gentle trot in about 4½ minutes, the next 400 yards at a round trot in 2 minutes 3 seconds, and the last 200 at a gallop in 30 seconds, the whole amounting to 7 minutes 3 seconds.

When great precision in laying is not required, a gun can fire 2 rounds of round shot in a minute, or 3 rounds of canister which requires less time in laying; each gun might fire 9 rounds of round shot upon the enemy during the first 400 yards, one round of round and two of canister in the next 400 yards, and two rounds of canister during the last 200, making a total from each gun of ten rounds of round shot and four of canister.

At the distance of 800 yards the range of common shot can be little depended on, at 400 it becomes more certain, but at 200 it is truly destructive; therefore, when an enemy is at the first named distance (800 yards) your fire should be slow, merely with a view to interrupt his manœuvres, and it also allows time; level your guns well at the second distance (400 yards) and fire briskly to check his march, and at the third (200 yards) quickly to break his line.

Round shot should be used from 350 yards upwards. The use of canister should begin at 350 yards and the quickness of fire increase as the range diminishes.

Double charges of canister may be used at 150 or 160 yards, spherical case should not be used at a less range than 650 yards.

Should the enemy be formed or forming behind a rising ground, or take post in a wood, shells should be fired.

Great attention is necessary not to cease firing round shot too soon in order to begin with canister; if the ground be not favorable the greater part of the balls are intercepted; round shot is true to its direction, and in ricochet hits the second line, if it misses the first.

Fire slanting at a line, direct at a column, with rapidity on the deployment of columns, slowly when beyond point-blank, with vivacity when within; never fire on Riflemen or single Soldiers.

In firing at a battery do not fire at any particular piece.

If the object it is wished to fire at is not seen, observe fixed marks near the spot so as to direct the firing.

When the enemy advances, fire rather in front of him, and when retiring rather beyond.

Fire canister against a line; round and spherical case shot against a column, and a line taken in flank. The same against all objects which have a greater depth than front, such as bridges, defiles, streets, gateways, &c.; use round and spherical case shot against Infantry; canister and spherical case shot against Cavalry. Fire round shot at men defending themselves in houses. Only fire canister on firm and hard ground. To destroy a building fire round shot against the walls and through the windows.

Use the direct or ricochet fire indiscriminately whenever you can take an enemy in its greatest length. Fire direct, and not in ricochet against the enemy's guns.

If you fire from a distance, attend more to the length than the depth of a line. If there is any difficulty in raking an enemy's line, attack it in front in preference to going from the protection of the Troops which escort the battery, or going from the Troops you may be sent to protect.

Avoid, in the heat of action, being drawn on unfavorable ground, the retreat of the enemy may be only a stratagem to draw you on. If the enemy fires on your battery extend your guns as much as possible so as to render his fire more scattered.

With guns of inferior calibre to those of the enemy, you must approach as near as possible, keeping beyond canister distance. In an attack do not keep too near the flanks of your own Troops for fear of firing on them : in a retreat the case is different there is no fear of firing on one's own Troops. When the Troops come to the charge fire on those nearest at hand to support the attack.

Howitzers are particularly useful in enfilading or ricocheting works or Troops, in firing into breaches to clear away the rubbish, and against mud walls where shot would only form a perforation, whilst shells act as small mines, In firing at Troops, common shells should be made to strike a little in front, and plunge into the line or column fired against.

Canister requires greater elevation to be given when fired with howitzers than with guns, it spreads so much as to be of little effect unless the enemy is very near. The effect of canister shot always depends on the nature of the ground, when it is fired over ravines and vallies to any distance the effect is very small, on soft ground the effect is also limited, on hilly ground where the balls cannot rebound no great effect is to be obtained, the most advantageous situation to employ it in, is upon hard level ground, where the balls rebound several times after grazing.

Spherical case should be made to explode full 50 yards in front of the Troops, much steadiness and care is required in loading the new howitzers, the wooden bottom is apt to turn up, and cause the shell to jam against the upper part of the bore.

The new howitzers are much longer than those formerly in use and their weight is made to correspond with guns in the same battery, they have a long range, carry very correctly, and when fired at point blank make innumerable ricochets.

Round shot has been recommended, but as from the smallness of the charge they would be useless in breaching, it is better to carry the usual proportion of shells, canister and spherical case shot, than diminish their number by the admission of a few shot which are inferior in effect.

It is scarcely necessary to caution an Artillery man against abandoning his guns, and allowing them to be taken by the enemy, yet there are situations in which "the men" are more valuable than "the ordnance," guns may be easily replaced, men not : it however requires an established character and great judgment in an Officer to be able to act on such occasions with decision and propriety. As a general rule, guns should never be abandoned, the last discharges are the most destructive and may turn the fate of the day ; at all events a protracted resistance will ever redound to the credit of the Artillery. When it is resolved however to abandon guns, they should be spiked and disabled in every possible way, the spunges broken, ammunition, &c. destroyed, and carriages burnt if time will permit, every thing should be done to prevent the enemy being able to use them.

Table of Light Guns and Howitzers.

NATURE OF ORDNANCE.	Calibre.	LENGTH OF		Weight.			CHAMBER.			Proportion between the Shot and Gun.
		Gun or Howitzer.	Bore.				Length.	DIAMETER.		
								Superior.	Inferior.	
	ins.	ins.	ins.	cwt.	qrs.	lbs.	ins.	ins.	ins.	
GUNS.										
Brass 9 Pdr. .	4.2	66.	63.	10	0	0	0	0	0	124
,, 6 ,,	3.668	60.	57.47	6	0	0	0	0	0	112
,, 3 ,,	2.913	48.	46.	3	0	0	0	0	0	112
HOWITZERS.										
Iron 10 Inch.	10.	60.	58.75	40	0	0	11.25	10.	7.5	0
,, 8 ,,	8.	48.	46.8	20	0	0	9.5	8.	6.	0
Brass24Pr.hy.	5.66	56.6	54.8	13	2	0	8.5	5.66	4.25	0
,, ,, light	5.66	48.	46.8	10	0	0	8.5	5.66	4.25	0
,, 12 ,,	4.52	45.2	44.3	6	2	0	6.8	4.52	3.4	0
,, 5½ In. heavy	5.66	32.3	29.5	10	0	0	7.02	4.215	4.215	0
,, 4⅖ ,,	4.52	22.6	20.9	2	2	0	4.8	2.26	2.26	0

Table of Powder allowed for various purposes.

NATURE OF ORDNANCE.	PROOF OF				Service.		Saluting.		Bursting common shells.		Bursting sphr. case shot.	Starting fuze.	Scaling.
	Gun or Howitzer.		Carriage.										
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	oz	oz.	oz.
GUNS.													
Brass 9-pounders.	3	0	2	4	2	4	1	8	0	0	3½	0	8
„ 6 „	2	0	1	8	1	8	1	0	0	0	2½	0	4
„ 3 „	1	0	0	12	0	12	0	8	0	0	1	0	4
HOWITZERS.													
Iron 10 inch.	14	0	7	0	7	0	0	0	2	10	0	3	12
„ 8 „	8	0	4	0	4	0	0	0	1	14	15	2½	10
Brass 24-pr. heavy.	3	0	2	8	2	8	1	8	0	12	6	1¼	8
„ „ „ light.	3	0	2	0	2	0	1	8	0	12	6	1¼	8
„ 12 „	1	8	1	4	1	4	1	0	0	6	4½	1	4
„ 5½ in. heavy.	3	0	2	8	2	0	1	0	0	12	6	1¼	8
„ 4⅖ „	0	8	0	0	0	8	0	6	0	6	4½	1	4

Table of Shot for Light Guns.

NATURE OF ORDNANCE.	Round.				Canister.			Spherical Case.		
	Diameter.		Weight.		Balls.	Weight.		Musket Balls.	Weight filled.	
	Maximum.	Minimum.								
	inches.	inches.	lbs.	oz.	No.	lbs.	oz.	No.	lbs.	oz.
Brass 9 Pdr.	4.1	4.06	8	13	60	9	4	41	7	10
„ 6 „	3.568	3.532	5	15	44	6	4	27	4	15
„ 3 „	2.833	2.803	2	15	41	3	1	11	2	3

Table of Shot and Shells for Howitzers.

NATURE OF ORDNANCE.	Shells Common.				Canister.			Sphr. Case.		
	Diameter.		Weight empty.		of Balls.	Weight.		Musket Balls.	Weight filled.	
	Maximum.	Minimum.								
	ins.	ins.	lbs.	oz.	No.	lbs.	oz.	No.	lbs.	oz.
Iron 10 inch.	9.88	9.8	88	0						
„ 8 „	7.95	7.85	41	3				337	56	6
Brass 24-Pr.	5.62	5.57	15	0	90	19	4	130	20	0
„ 12 „	4.476	4.432	7	8	76	12	8	63	10	2
„ 5¼ in. hy.	5.62	5.57	15	0	90	19	4	130	20	0
„ 4⅖ „	4.476	4.432	7	8	76	12	8	68	10	2

Number of Men, Disposition and Duties in the Service of Light Field Ordnance.

Not less than 6 men, (unless from necessity) will be posted to any description of Ordnance, except the smaller natures.

When the Detachment consists of less than 6 men, the higher numbers are struck out and additional duties imposed on those remaining.

Two Men.—No. 1, Commands, lays, serves the vent, and fires. No. 2, spunges, loads, and serves ammunition.

Three Men.—No. 1, Commands, lays, serves the vent, and fires. No. 2, spunges. No. 3, loads, and serves ammunition.

Four Men.—No. 1, Commands and lays. No. 2, spunges. No. 3, loads, and serves ammunition. No. 4, serves the vent, and fires.

Five Men.—No. 1, Commands and lays. No. 2, spunges. No. 3, loads and serves ammunition. No. 4, serves the vent. No. 5, fires.

Six Men.—No. 1, Commands and lays. No. 2, spunges. No. 3, loads, No. 4, serves the vent. No. 5, fires. No. 6, serves ammunition.

Seven Men.—No. 7, attends the limber, and serves ammunition to No. 6, and occasionally changes with him. The other numbers as before.

Eight Men.—No. 8, assists No. 7, and occasionally relieves No. 2. The other numbers as before.

Nine Mem.—No. 9, attends the ammunition waggon. The other numbers as before.

The following Stores are required for the Service of Light Field guns and howitzers.

1 Spunge.
1 Priming Pouch.
1 Pricker.
1 Bitt.
1 Saw.
1 Portfire Stock.
1 Auger Fuze.
1 Box dredging.
1 Funnel.
1 Worm.

1 Rasp.
1 Driver and Setter.
1 Bucket.
1 Lintstock.

Method of placing Light Guns in position.

The Officer Commanding a battery should be in communication with the Commandant of the Troops relative to the position of the batteries. He must know the principal points of attack, in order that he may dispose of his batteries so as not to interfere with the march of the other Troops and not to take up positions which would be better occupied by others.

Batteries attached to Divisions and marching with them, must be detached from them to be placed in position during an action, on such points as may be fixed on by the Commandant.

3. Taking up a position with a battery requires a perfect knowledge of its power, so that according to the ground and the distance, it may do all the mischief possible to an enemy without being unnecessarily exposed.

To know and be able to judge correctly of distances is of the greatest assistance. From 220 to 230 yards all the parts of a man's body are distinguishable by a person with common sight. From 400 to 480 yards you can no longer see all the parts, but you do the head, the body, the arms and motions, as well as the muskets of the men, this is a little beyond point-blank distance. At 600 yards the head and lower parts of the body are still to be distinguished. At 700 and 800 yards the body appears a lengthened form, the legs of men in motion and that of the arms extended or sideways are still distinguishable. At 900 and 1000 yards the files and movements of Troops are still to be distinguished.

At 300 yards distance cut the ground short of the feet.
„ 400 „ ...... „ ......point the gun at the feet
„ 500 „ ...... „ ...... „ ......thighs.
„ 600 „ ...... „ ...... „ ......body.
„ 700 „ ...... „ ...... „ ......shoulders.
„ 800 „ ...... „ ...... „ ......head.

In taking up a position stony ground should be avoided; in an open country the Artillery formed in large or small batteries which mutually support each other is generally placed in the wings, in front of the interval between brigades, in front of columns whilst forming, generally in all the weak and menaced points. If the ground is intersected, the Artillery must take advantage of all favorable spots and avoid all others. Small heights will enable the fire to be condensed and discover the enemy at greater distances. Villages are equally favorable as they reduce the attack to the opening of the street.

Do not place your guns on the highest grounds, one-third of the shot which would reach the object if fired from a level plain would be lost; a gentle slope is preferable. If obliged to occupy heights, have some guns on the sides and lower down so as to command the bottom of the heights.

Take advantage of broken ground to cover your guns, or whenever there is time erect artificial ones.

A small epaulement two or three feet in height along the extent of your front, will protect you from musketry and canister shot.

A small rise in the slope of a terreplein or platform is a good position. If as far as 200 or 300 yards in front of your position the ground is swampy and broken up by holes and ravines, the enemy's shot will not injure you. It is however necessary to remark, that although these positions are good for defensive operations they tend to clog movements.

On ground not level and undulated, a front formation between two hillocks perpendicularly to the direction of the valley is worst of all. If there is a valley between you and the enemy, ricochet firing is useless, in such a circumstance endeavour to command the enemy. If you occupy a wood, you must cut down the wood near the position, throw up an abattis, place the guns en barbette, and enfilade the communications and roads—take up positions between the openings and cover yourself as soon as possible.

An Officer Commanding a battery is under the orders of the Officer Commanding the Division to which he is attached.

Before an action he ought to know the dispositions for attack and defence, the ground to be occupied and the object to be accomplished.

He should direct the elevation and nature of ammunition to be used.

He should watch that the ammunition is not thrown away.

He should reconnoitre the ground in every direction.

He should always know the exact state of his ammunition and where to get fresh supplies.

After an action, the Personel and Materiel of the battery should be carefully examined and all wants and repairs promptly made.

All the Limbers should be filled with the remaining ammunition, and the empty waggons sent for fresh supplies.

The Officer Commanding should forward a report in which is fully detailed the actual state of the battery, the conduct of all, the different positions he took up during the action, the effect his fire appeared to produce and the behaviour of all those who may have distinguished themselves.

Method of laying a piece of Ordnance.

To lay a piece of Ordnance is to place it in such a position, that the shot may reach the object, which it is intended to strike.

For this purpose it is necessary,

That the eye of the person who lays the gun, and the two notches one on the top of the base-ring, and the other on the swell of the muzzle be brought into a straight line with the object.

That the proper elavation be given to throw the shot the required distance.

The line of direction is taken entirely from the trail, which by a little practice can be done with facility and great correctness, the trail being traversed by No. 1, by means of the handspike.

The elevation must be given at the breech.

When the gun is laid, so that the notch on the top of the base ring and the notch at the top of the swell of the muzzle, coincide with the object, the gun is said to be laid by the line of metal. In this case, in consequence of the dispart, which is half the difference between the diameter of the gun at the base-ring and at the swell of the muzzle, the gun will always have some elevation, this will be greater or less according to the length of the gun, and the difference between the diameters. In general it is about one degree.

Howitzers have a piece of metal cast on the muzzle which is also called the dispart, so that when the howitzer is laid by the line of metal it is point blank. This equally applies to guns which have a dispart.

The tangent scale must be used for all elevations above three degrees, and indeed it is better to use it whenever the elevation is more than the line of metal. It is divided into quarters of degrees, the length of which depends on the nature and length of the gun. When it is used, it should be drawn out till the required elevation appears just at the top of the pipe, when the screw is turned to fix the scale. The line of direction is given as before from the trail, and the elevation from the breech, by lowering it till the notches in the top of the scale and at the swell of the muzzle coincide with the object.

When great accuracy is required, the line of direction should be taken at the breech by the line of metal and the elevation given afterwards.

When one wheel stands lower than the other, the gun will throw the shot out of the direction towards the lowest side, if it be laid by the line of metal; it should therefore not be laid directly on the object, but an allowance should be made, which must be increased in proportion to the difference of the level of the wheels and the increase of range.

Upon giving the word "Load" No. 1, takes hold of the end of the handspike with the right hand, and the centre of it with the left, placing his left knee against his left hand,

and bending over it, the right knee slightly bent, he looks over the top of the gun and gives the direction. He then steps up to the breech to give the elevation, which he does by taking hold of a horn of the elevating screw, drawing back the right foot and bending over the left knee. In the drill of Recruits No. 1, should be made to name the elevation and range previous to stepping up to the breech.

Night Firing.

Light guns are seldom required to be fired at night as it merely tends to waste ammunition.

When guns are kept in position at night in cases of sudden alarm, they should be loaded with canister and the charge drawn in the morning which can easily be done with the wadhook.

Ranges with Light guns—Round Shot.

Elevation.	9-Pounders.	6-Pounders.	3-Pounders.
degrees.	yards.	yards.	yards.
P. B.	300	200	
¼	400	300	
½	500	400	
¾	600	500	
1	700	600	
1¼	775	650	
1½	850	700	
1¾	925	750	
2	1000	800	
2¼	1050	850	
2½	1100	900	
2¾	1150	950	
3	1200	1000	

Ranges with Howitzers with Common Shells and Service Charge.

24-Pounders.			12-Pounders.			5½-ins. heavy.			4⅖-inches.		
Eleva-tion.	Fuze.	Range.	Eleva-tion.	Fuze.	Range.	Eleva-tion.	Fuze.	Range.	Elevn.	Fuze.	Range.
deg.	ths.	yds.	deg.	ths.	yds.	deg.	ins.	yds.	deg.	ins.	yds.
P.B.	0	250	P.B.	0	200	1	.4	453	4	.6½	500
¼	0	300	¼	0	250	2	.8	595	6	.8	600
½	0	350	½	0	300	3	.8	666	10	1.1½	800
¾	0	400	¾	0	350	4	1.0	847	12	1.4½	1000
1	1	450	1	1½	400	5	1.2	957	14	1.6	1200
1¼	1½	500	1¼	2	450	6	1.4	1173			
1½	2	550	1½	2½	500	7	1.8	1149			
1¾	2½	600	1¾	3	550	8	1.6	1355			
2	3	650	2	3½	600	9	1.6	1585			
2¼	3½	700	2¼	4	650	10	2.0	1853			
2½	4	750	2½	4½	700	11	1.8	1793			
2¾	4½	800	2¾	5	750	12	.2	1686			
3	5	850	3	5½	800	0	.0	0			

Spherical Case Shot—Guns.

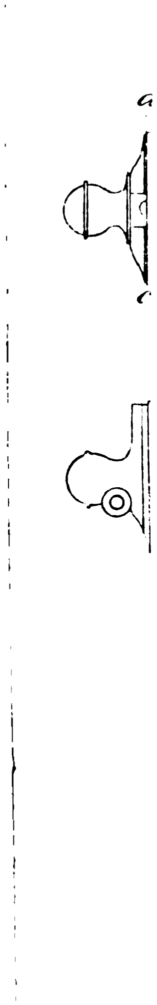
9-Pounders.				6-Pounders.			
Eleva-tion.	Fuze.	Range		Elevation.	Fuze.	Range.	
		From	To			From	To
deg.	ths.	yards.	yards.	deg.	ths.	yards.	yards.
1¼	2	640	920	1¼	2	570	800
1¾	3	800	1060	1⅝	3	720	930
2¼	4	930	1180	2¼	4	845	1040
2¾	5	1050	1290	2⅞	5	955	1145
3¼	6	1160	1390	3⅜	6	1060	1240
3¾	7	1260	1480	4	7	1160	1335
4⅜	8	1360	1570	4⅝	8	1255	1415
5¼	9	1455	1655	5¼	9	1345	1500
5¾	10	1555	1700	5⅞	10	1430	1580
6¼	11	1640	1820	6⅝	11	1510	1655
				7¼	12	1585	1725

Spherical Case Shot—Howitzers.

RANGE.	24Pdrs.		12Pdrs.		5½ ins. heavy.		4⅖ inch.	
	Elevation.	Fuze.	Elevation.	Fuze.	Elevation.	Fuze.	Elevation.	Fuze.
	deg.	ths.	deg.	ths.	deg.	ths.	deg.	ins.
650.............	2	3	2¼	3	3¼	4½	4¾	.4
900.............	3	5	3⅓	5⅓	4¾	6½	8½	.8
1100.............	4	7	5	8	6¼	8½	10	1.1
1200.............	5	8	5¾	9	7¼	9½	11	1.2

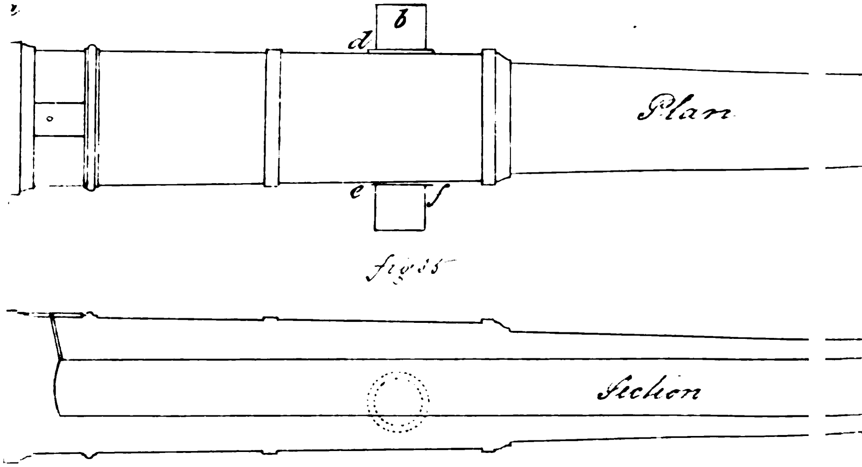
Ricôchét Practice with Common Shells.

RANGE.	24-Pdrs.			12-Pdrs.			5½ inches heavy.			4⅖ inches.		
	Charge		Elevation.	Charge		Elevation.	Charge		Elevation.	Charge		Elevation.
	lbs.	oz.	deg.	lbs.	oz.	deg.	lbs.	oz.	deg.	lbs.	oz.	deg.
300....	0	8	4⅓	0	0	0	0	10	4	2	13	11
400....	0	9	4¾	0	5	7½	0	12	5	3	6	13
400....	0	6	7½	0	4	8	0	8	8	3	12	11
500....	0	12	5⅓	0	8	4	0	12	7½	4	0	15
500....	0	10	7½	0	6	6	0	10	9⅓	6	0	13
500....	0	8	9	0	5	9	0	8	11½	6	10	12
600....	1	0	4¾	0	10	5¾	1	0	6¾	7	0	12
600 ...	0	12	9	0	6	6½	0	12	9	7	8	10
600....	0	0	0	0	8	8	0	0	0	8	0	10


a
c

Ar

Brass Guns



figs 5

Table of W

	Weigh	
	cwt	[illegible]
9 Pd^r Gun	10	.
6	6	.
3	3	.
24 How: English heavy	13	
24 Bengal light	10	.
12	6	2
5½ inch Heavy short	10	

y.

Brass Howitz

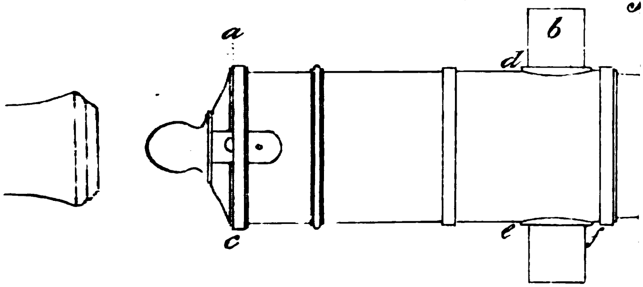
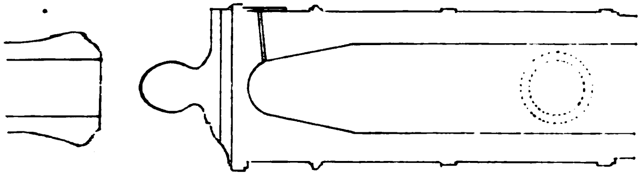


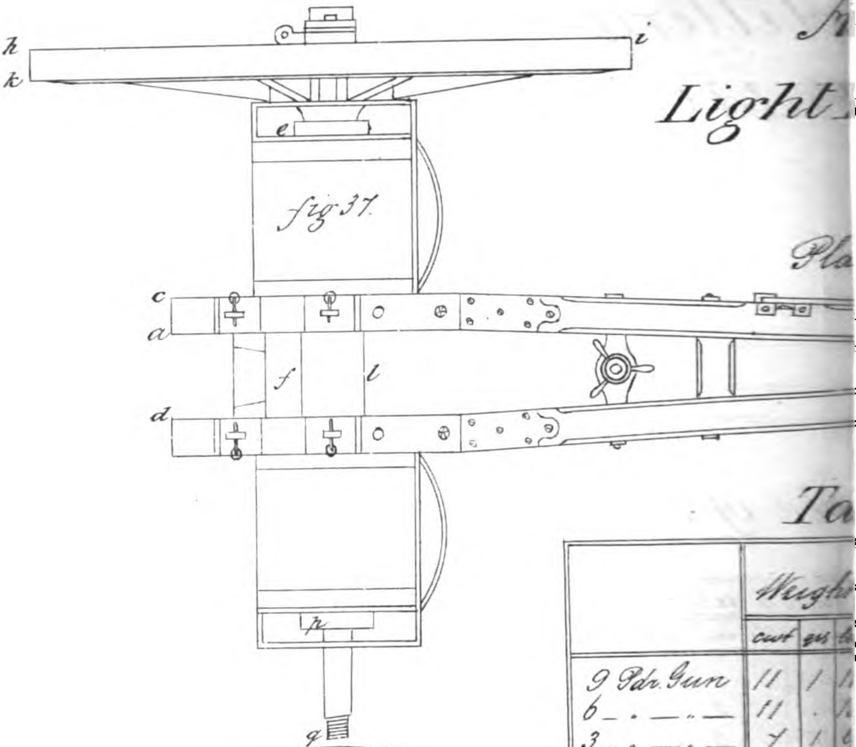
fig 36



nensions.

	ngth		Diameter							
	from a to b		of the Bore		at a c		at d e		at e f	
ins	ft	ins	ins	ths	ins	ths	ins	ths	ins	ths
	30	.	4	2	16	8	[illegible]		[illegible]	4.5
	26	5	3	6.6	9	6.2	[illegible]	[illegible]	[illegible]	
	21	4	2	9.1	7	6	[illegible]	3	2	3.5
4 ½	2	1	5	6.6	12	7.5	12	5	4	2
8 ½	1	9.6	5	6.6	13	1	11	1.5	3	9
6 ⅞	1	7.8	4	5.2	10	2	9	8	3	6
7 ½	1	4.5	5	6.6	13	5	13	5	4	[illegible]

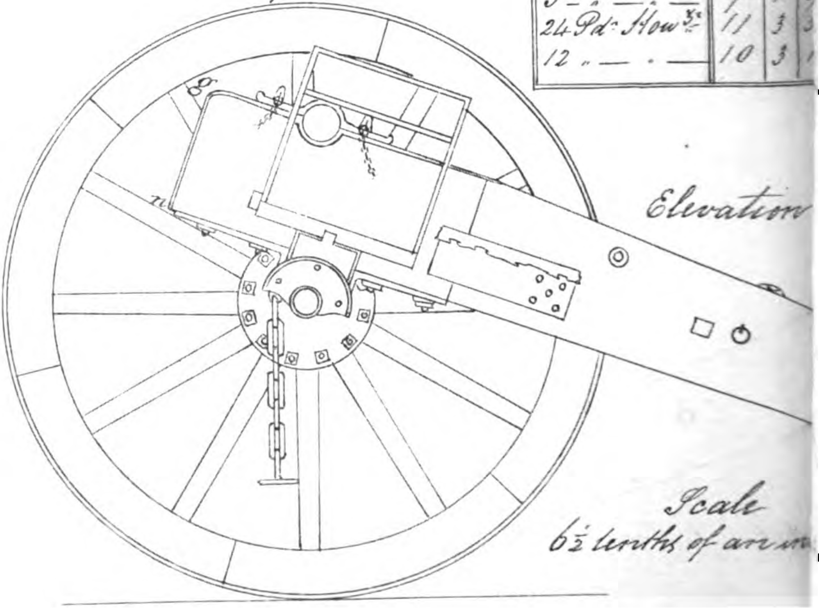
Light



Pla

Ta

	Weigh		
	cwt	qrs	[illegible]
9 Pdr. Gun	11	1	[illegible]
6 — " — " —	11	.	[illegible]
3 — " — " —	7	1	[illegible]
24 Pdr. How^{3r}	11	3	[illegible]
12 " — " —	10	3	[illegible]



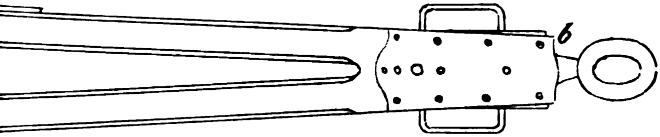
Elevation

Scale
6½ tenths of an

rtillery.

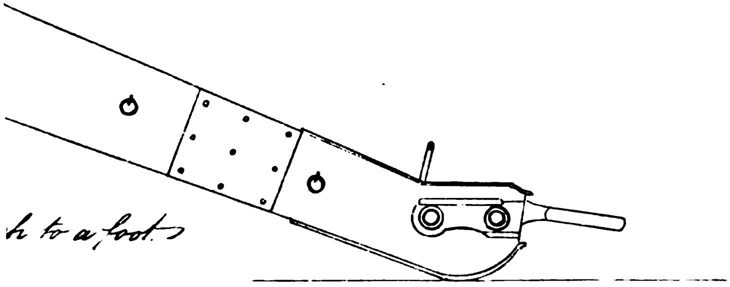
Field Carriages.

n



ble of Dimensions.

Length from																	
a to b		a to c		a to d		g to n		e to p		f to l		p to q		h to i		h to k	
ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths
118	.	3	5	9	.	13	.	44	.	6	.	10	.	59	5	3	
116	.	3	.	7	8	11	.	44	.	6	.	10	.	59	5	3	
103	.	2	5	6	3	10	.	44	.	5	.	10	.	59	5		
119	.	5	1·2	11	1·5	15	.	44	.	6	.	10	.	59	5	3	.5
117	.	4	2·5	9	8	12	.	44	.	6	.	10	.	59	5	3	.



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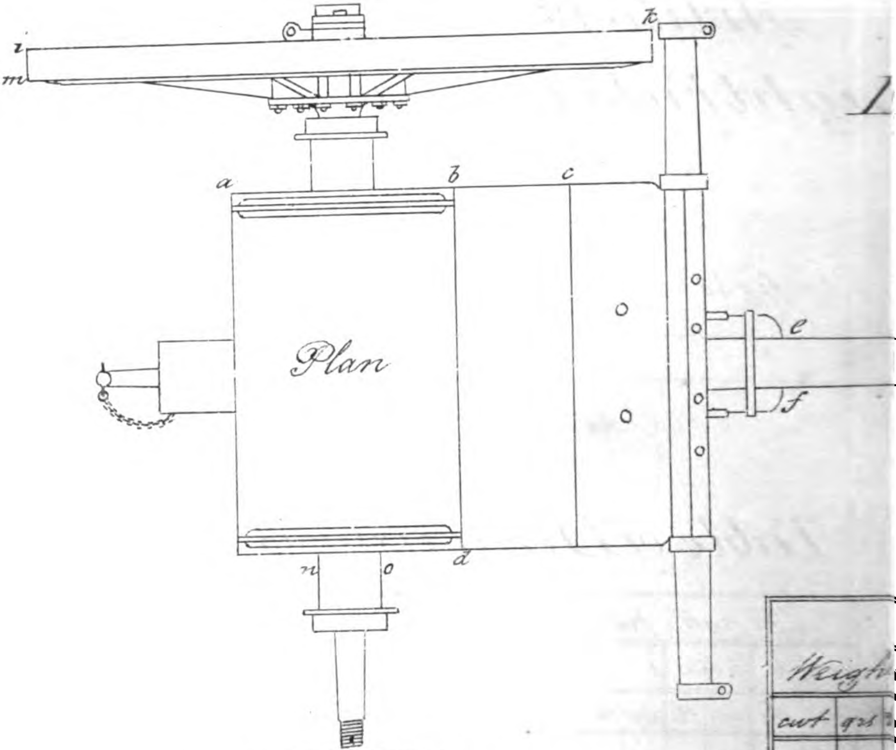
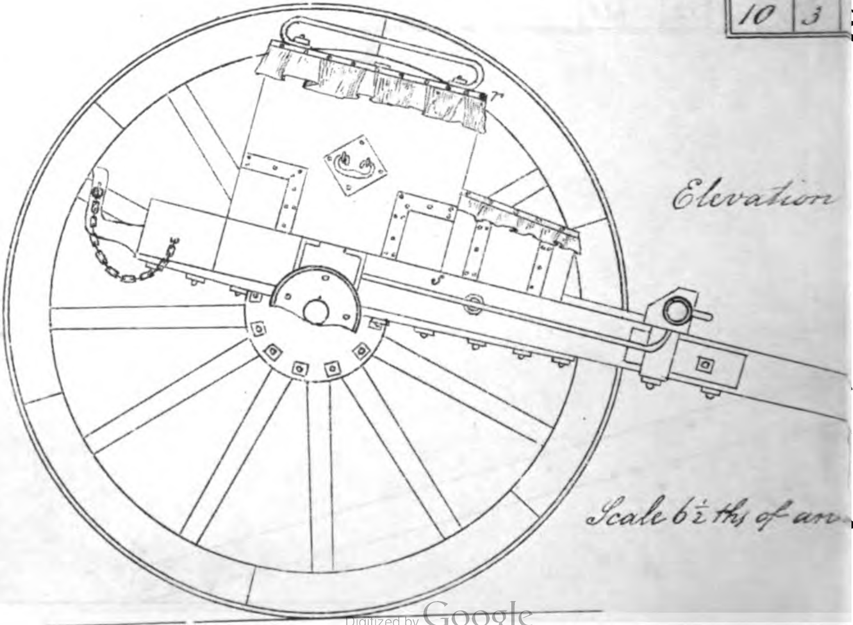
L



Weigh		
cwt	qrs	
10	3	



Elevation

Scale 6½ ths of an

Artillery.

ight Field Limber.

fig 38.

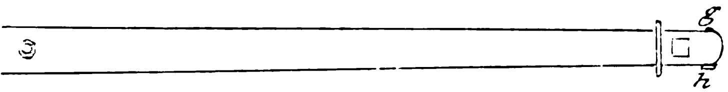
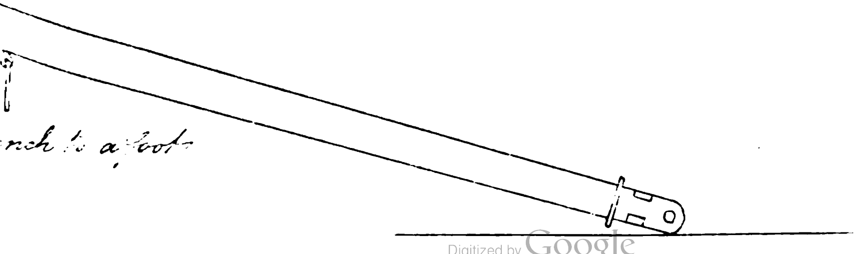


Table of Dimensions.

Length from										Diameter at							
a to b		b to c		b to d		n to o		r to s		e f		g h		i k		i m	
ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths	ins	ths
21	.	12	.	36	.	6	.	19	.	4	.	3	.	50	5	3	

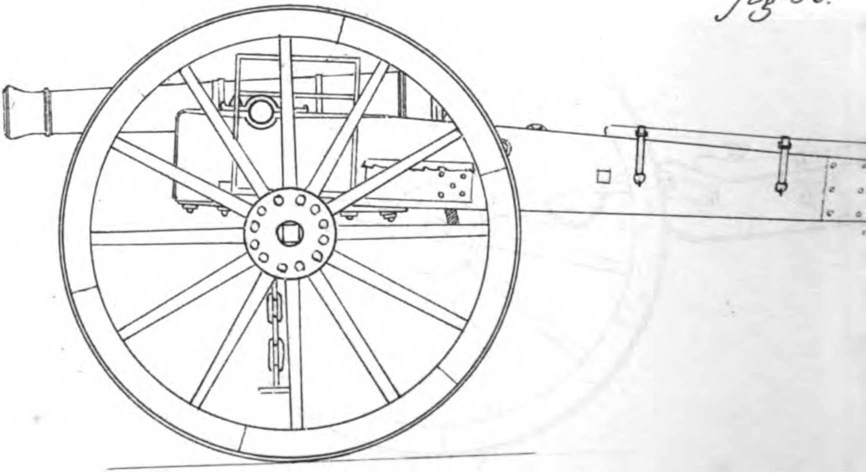


nch to a foot

Artille

Brass Gun

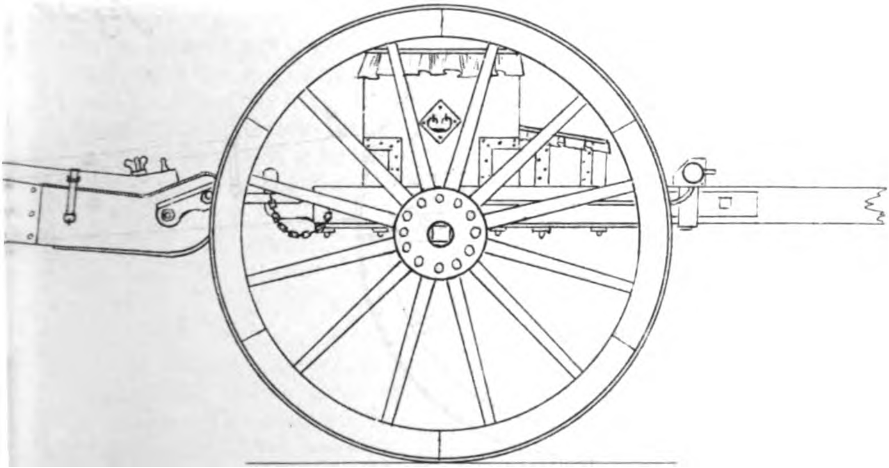
fig 39.



Scale 4½ tenths of an in

ry.

Mounted.



ch to a foot

CARRIAGES USED FOR THE CONVEYANCE OF HEAVY ORDNANCE AND ORDNANCE STORES.

PLATFORM CART.

Fig. 40.

A platform cart consists of a wooden floor supported on an axle and wheels ; it is used for the transport of all kinds of Military Stores, and will carry 1200 lbs. weight with 4 bullocks and 700 lbs. with 2 bullocks.

This carriage has wooden naves with metal boxes, to prevent the friction of the axletree.

MORTAR CARTS.

Fig. 41.

A mortar cart is nothing more than a large platform cart, having 8 lashing rings, 4 on each side, it will carry one 10 inch, or two 8 inch, or four 5½ inch mortars with beds complete : 13 inch mortars are seldom or ever used on account of their weight, but if necessary to transport them they must be slung to a transport carriage.

STORE WAGGON OR CART.

Fig. 42—43.

The store waggon or cart, is the same as the platform cart, only it has sides with two lids and a partition in the centre. The waggon is made with a limber and the cart without. These carriages have brass naves and the wheels and axletrees correspond with those of the 6 pounder gun carriage and limber.

FORGE WAGGON OR CART.

Fig. 44—45.

The forge waggon or cart, is the same as a store cart, excepting it has no lid or division in the centre, but carries a stand with a pair of large forge bellows. The waggon is made with a limber and the cart without. They have brass naves, and the wheels and axletrees correspond with those of the 6 pounder gun carriage and limber.

AMMUNITION CART.

Fig. 46.

The ammunition cart is constructed on the principle of the platform cart, but instead of a wooden floor, it has only a skeleton frame, on which are fastened three ammunition boxes, carrying ammunition.

The wheels and axletrees are similar to those of 6 pounders. The boxes are all of the same dimensions and packed in a similar manner. Each box has three lockers.

AMMUNITION WAGGON.

Fig. 47.

The ammunition waggon differs from the ammunition cart in having a limber attached to it, in which it is enabled to carry so many more rounds.

The wheels and axletree correspond with those of 6 pounders. The limber corresponds exactly with the gun limber, and on service the one may be substituted for the other at pleasure; the waggon boxes are all of the same dimensions, and are packed in a similar manner. Each box has three lockers.

The centre partition of each box with carts and waggons is fitted with water-proof copper boxes made to lift out whenever necessary. The shot &c. are carried in the other two. The advantage of the copper box is effectually to guard against accidents by fire or water. With these boxes, no grains of the powder can possibly get amongst the shot, as was sometimes the case when a cartridge burst. In crossing rivers these boxes are very convenient on such occasions, unless the water is so high as to flow over the top of the limber or waggon, the river would be crossed at once without the inconvenience and delay of unpacking the ammunition.

TRANSPORT CARRIAGE.

Fig. 48.

The bad roads in India led to the adoption of transport carriages, experience having shewn, that by this means, guns can be much easier removed than when on their own carriages, where the weight of the piece, previous to the introduction of travelling trunnion boxes, was not properly divided between the four wheels and so caused an excessive weight laying on the gun wheels, soon rendering them unserviceable. A transport carriage consists of an axletree with two cheeks mounted on two very high wheels, to keep the gun which is slung underneath clear off the ground, or any obstacle on the road; these cheeks are attached to the axletree and the whole connected to a common limber.

To sling a gun, it is laid on the ground and raised with handspikes to allow of a small log of wood being placed under the muzzle and another under the breech, to admit the lashing ropes passing freely under the piece; the carriage is unlimbered and placed with a wheel on each side of the gun. The cheeks are raised so as to lower the hind part as near the breech as possible to which it is firmly lashed with strong ropes, the cheeks are then hauled down nearly to touch the muzzle, which is lashed to them, the carriage limbered up.

To unsling the gun, the carriage is unlimbered, the cheeks are raised, and the muzzle lowered till it rests on a log of wood placed to receive it, when the lashings are undone and the cheeks allowed to raise gently until the breech rests on its log it is then unlashed, and the carriage withdrawn from over the gun. To save the strain on the lashings when the carriage is halted or after a march, a log of wood should be placed under the breech and muzzle for the gun to rest on. Transport carriages are likely to become obsolete, from the introduction of a second set of trunnion boxes to heavy carriages these are cut about two and half feet in rear of the first. The gun is placed in these when travelling, and consequently the weight of the gun is more equally divided between the two axletrees, it lays more snugly, the draft is easier, and the carriage less exposed to injury by unsteady and irregular motion.

The following articles of store are necessary for the draft of gun carriages, heavy or light.

YOKES.

Yokes are required when bullocks are used in draft, there are two kinds, the new Regimental yoke and the old common one. The Regimental yokes (Fig. 53) are used either as pole or trace yokes indiscriminately. When required for the pole, a clip band and swivel is necessary, the swivel (Fig. 54) embraces the end of the pole, and on its bolt the clip band (Fig. 55) is fixed, the yoke is passed through the clip band, and the whole fastened by a screw-nut. The trace yoke is attached by its hooks to the branches of the trace chain; these yokes are only intended for the field batteries attached to the Foot Artillery. With the park and on all occasions of sending carriages from one station to another, the old common and quadruple yokes are used. The common pole yoke (Fig. 52) is attached by a bolt or pintle fixed to the pole, and which runs through a hole made in the centre of the yoke. The trace yokes (Fig. 51) are fastened by a T to the trace chains. The number of these yokes depends upon the weight of the carriage, or number of bullocks attached to it. When there are many bullocks attached to a carriage, quadruple yokes (Fig. 49, 50) are used with all the bullocks excepting one pair which invariably heads the team.

POLE BARS.

Fig. 56.

Pole bars are required with horses, and were introduced into the Horse Artillery, when the rocket carriages were received from England, the advantages they possess over the old pole strap, are, that the horses heads are not so much confined and that the draft is in consequence more parallel than with the strap, which being fixed to a ring under the collar of each pole horse draws their heads in towards the pole and naturally forces out their rumps. The bar passes through the ring to which the strap is buckled and moves along at the pleasure of the horse to a certain extent, sufficient to give his head full play. The pole bar is placed below the pole which causes the draft to be steadier and easier for the horses. They are made of iron and weigh 11½ lbs.

LINKING CHAIN.

FIG. 57.

An iron ring with two small chains and two hooks, applied to the end of the pole, it is used to prevent the ring of the pole heames slipping off the bar.

TRACE OR DRAFT CHAINS.

Are made of iron, the length of the chain and thickness of the links varying according to the nature of the Ordnance they are intended to draw. The chain is attached to the yokes and to the gun axletree by two extra pieces of chain. Light field trace chains (Fig. 58, 59) are divided into lengths for the purpose of removing refractory cattle, or if needed, attaching additional ones to assist in the draft.

Length and weight of Chain and diameter of Links.

	Length.							
	Gun axle branch.	Limber axle branch.	Yoke branch.	Chief chain to pole end.	Chief chain from pole to limber axle.	Chief chain from limber axle to gun axle.	Diameter of links.	Weight.
	in.	in.	in.	ft.	ft.	ft.	in.	lbs.
Iron 24 Pdr.	40	15	$19\frac{1}{2}$	70	10	$7\frac{5}{12}$	$\frac{7}{8}$	500
„ 18 „				63			$\frac{6}{8}$	400
„ 12 „				49			$\frac{5}{8}$	300
Mortar cart large.	36	0	19	34	$10\frac{1}{5}$	0	$\frac{7}{8}$	170
„ „ small	36	0	19	20	$10\frac{1}{2}$	0	$\frac{6}{8}$	80
Light field. Poletrace.	20	0	$11\frac{1}{2}$	0	0	0	$\frac{1}{2}$	25
Light field. Leading.	0	0	$11\frac{1}{2}$	0	0	0	$\frac{1}{2}$	$17\frac{3}{4}$
Transport carriage. . .According to the nature of Ordnance								

With heavy carriages the chain (Fig. 60) should be fixed to the axle of the gun and not the axle of the limber, by so doing the purchase is taken from the heavier part of a machine and the chain carried nearer to a level with the yokes. The 6 pounder chain of $\frac{4}{8}$ of an inch link will bear of strain of upwards of 9000 lbs. and this should be considered sufficient for our heavy carriages. Esses (Fig. 63) are always carried with heavy and light field carriages, being very useful in joining broken traces on a march.

PRESERVATION OF CARRIAGES.

All carriages should invariably be kept under cover in order to protect them from the weather, and the wheels turned at least once a month in order to prevent the weight resting always on the same spokes and felloes. If carriages are exposed to the weather and have wooden naves, the latter should be covered with cow-dung to prevent as much as possible their cracking, and water should occasionally be thrown over the wheels, otherwise the wood will shrink and the tires fall off. Carriages in constant use should have their wheels frequently greased, and be painted occasionally; those in store once in three years.

Three coats should be given to new carriages, or when considerable repairs have been made. The following are the proportions of materials for painting a 6 pounder carriage and limber.

	1st Coat.	2d Coat.	3d Coat.
White Lead..............lbs.	$8\frac{1}{4}$	$3\frac{3}{4}$	0
Lamp Black..............oz.	$18\frac{1}{4}$	$3\frac{3}{4}$	1
Linseed Oil.........ollucks.	$10\frac{3}{8}$	$4\frac{1}{2}$	18
Turpentine...........bottles.	$\frac{1}{4}$	$\frac{1}{4}$	0
Red Lead...............lbs.	0	0	2

In all considerable repairs, or periodical painting of carriages, the proportions specified for the 2d and 3d coats only are to be used and in many cases will be sufficient. The following quantity of paint is sufficient for one coat to each carriage.

Gun	24	Pounder	8	lbs.
„	18	„	7	„
„	12	„	7	„
„	9	„	6	„
„	6	„	5	„
Howitzer	5½	inch	6	„
„	24	Pdr.	6	„
„	12	„	5	„
Mortar	13	inch	3	„
„	10	„	2½	„
„	8	„	2	„
„	5½	„	1	„
„	4⅖	„	4¾	„

FIELD SERVCE.

The quantity of Artillery for Field Service, must be regulated by the nature of the service, and the enemy's means; the face, features, and general nature of the country, which is to be the scene of action, the state of the roads, the means of transport, the force and description of the troops composing the army or detachment.

List shewing the proportion of stores allowed to each single piece of Ordnance with the Madras Artillery, on occasion of taking the Field, given as a guide to Officers Commanding the Artillery with any expedition or Field force.

The Battering Train consists of:

Heavy Field.

Guns Iron	18	Pounders.
„ „	12	„
Mortars Brass or iron	8	Inch.
„ „	5½	„

Light Field.

Guns Brass	9	Pounders.
„	6	„
Howitzer Brass	5½	in heavy.
„ „	24	Pounders.
„ „	12	„

	HEAVY FIELD ORDNANCE.				LIGHT FIELD ORDNANCE.				
	Guns.		Mortars.		Guns.		Howitzers.		
	18 Pdr.	12 Pdr.	8 in.	5½ in.	9 Pdr.	6 Pdr.	24 Pdr.	5½ in.	12 Pdr.
ORDNANCE MOUNTED.	1	1	1	1	1	1	1	1	1
AMMUNITION.									
Shot round	1000	1200	0	0	52	72	0	0	12
„ canister	25	25	0	0	40	54	19	19	23
„ spherical case filled	0	0	0	0	14	18	17	17	38
Shells common	0	0	400	500	0	0	55	55	68
Carcasses iron filled	0	0	10	10	0	0	5	5	5
Balls fire	0	0	20	20	0	0	0	0	0
Cartridges serge filled	0	0	0	0	114	185	96	96	164
„ empty spare	0	0	0	0	16	20	9	9	18
„ cloth filled	25	25	0	0	0	0	0	0	0
„ „ empty	1100	1320	440	550	0	0	0	0	0
„ „ filled bursting common shell	0	0	0	0	0	0	55	55	68
„ „ „ S. C. S.	0	0	0	0	14	18	17	17	38
Gunpowder L. G. 45lb. barrels	134	108	38	15	0	0	0	0	0
					lb.	lb.	lb	lb.	lb.
„ S. G. 45lb.	1	1	0	0	9	9	[illegible]	1	0
„ Mealed lbs.	0	0	25	25	1	1	1	6	9
Fuzes common	0	0	800	1000	0	0	76	70	81
„ S. C. S.	0	0	0	0	30	30	30	3½	58
Match cotton——skeins	6	6	6	6	3	3	2½	21	20
„ quick „	¼	¼	10	10	1	1	1	0	0
Lights blue Rockets single	50 with the Park.								
Portfires	50	50	0	0	30	60	40	40	40
STORES.									
Adzes brass cooper	One to a Brigade of Heavy Ordnance								
„ iron	One with the Park.								
Anvils „ smiths	One to 3 Brigades of Heavy Ordnance.								
Aprons canvas gun	1	1	0	0	0	0	0	0	0
Augurs fuze brace	0	0	1	1	1	1	1	1	1
„ fuze hand	0	0	1	1	1	1	1	1	1
„ iron carpenters	One to a Brigade of Heavy Ordnance.								
Axes broad with helves	2	2	2	2	0	0	0	0	0
„ felling	2	2	2	2	0	0	0	0	0
„ hand	2	2	2	2	0	0	0	0	0
„ pick	6	6	6	6	2	2	3	3	3
Axletree, heavy field carriage. „ „ light	1 Spare to 6 Carriages.								
„ „ platform carts	1 Spare to 12 Carts.								
Bags gunny powder	1 to every 45lb. Barrels of Powder.								

	Heavy Field Ordnance.				Light Field Ordnance.				
	Guns.		Mortars.		Guns.		Howitzers.		
	18 Pdr.	12 Pdr.	8 in.	5½ in.	9 Pdr.	6 Pdr.	24 Pdr.	5½ in.	12 Pdr.
Stores.									
Bags gunny shot and shell.	183	132	113	70	0	0	0	0	0
„ „ packing stores.	Numbers ascertained after packing.								
„ cloth sand 2 bushel	1680 or								
„ „ „ 1 „	3360 or	To 1 Brigade Heavy Guns and Mortars.							
„ „ „ ½ „	6720								
Bags canvas powder	2	2	2	2	0	0	0	0	0
Bamboos large	25	25	25	25	0	0	0	0	0
„ small	50	50	50	50	0	0	0	0	0
Barrels budge.	1	1	0	0	0	0	0	0	0
Barrows hand	2	2	2	2	0	0	0	0	0
Baskets common	100	100	50	50	0	0	0	0	0
Bearing leathers.	One to each shell mortar.								
Beds mortar spare	One to 2.8 in. or 4.5½ in. mortars.								
Bellows forge Europe large.	One to 3 Brigades Heavy Ordnance.								
„ smith country	2	2	1	1	0	0	0	0	0
„ hand, proving shells.	One to a Brigade of Mortars.								
Benches fuze complete	One to four Mortars.								
„ standing vice „ armourers	One to three Brigades of Heavy Ordnance.								
Bits, steel gun	2	2	1	1	2	2	2	2	2
Bittelas, cubits.	½	½	½	½	0	0	0	0	0
Black lamp lbs.	½	½	½	½	0	0	0	0	0
Blocks wooden spare	2	2	2	2	0	0	0	0	0
„ gin spare setts	One to each Gin.								
Bottles copper filled with spirits of wine	0	0	1	1	1	1	1	1	1
Boxes dredging	0	0	1	1	1	1	1	1	1
„ quick match	0	0	1	1	1	1	1	1	1
„ tube with straps	1	1	0	0	1	1	1	1	1
„ fuze	0	0	0	0	1	1	1	1	1
Borax lbs.	4	4	4	4	0	0	0	0	0
Bratties.	1200	1200	1200	1200	0	0	0	0	0
Brushes hair painting	2	2	2	2	0	0	0	0	0
Buckets water gun	4	4	3	2	1	1	1	1	1
„ wooden tar	1	1	1 to each M. Cart		1	1	2	2	2
Bunting of colours....piece.	One to a Brigade heavy Ordnance.								
Carriages transport with limber	1	1	If the carriages have no travelling trunnion holes.						
„ heavy field „ spare	One to 2 pieces.								
„ light do. „ „	One to 6 pieces.								
Carts Mortar—	One to two 8 inch or 4 5½ inch Mortars.								

	Heavy Field Ordnance.				Light Field Ordnance.				
	Guns.		Mortars.		Guns.		Howitzers.		
Stores.	18 Pdr.	12 Pdr.	8 in.	5½ in.	9 Pdr.	6 Pdr.	24 Pdr.	5½ in.	12 Pdr.
Carts Platform..............	One Cart to carry 700 lbs.								
„ Artificers.........	One to 3 Brigades heavy ordnance.								
„ Ammunition......	0	0	0	0	2	1½	3	3	3
„ Laboratory on which the laboratory chest is placed..............	One to 2 Brigades of Mortars.								
Candles Wax..............	50	50	50	50	0	0	0	0	0
Canvas Europe ...bolts....	1	1	1	1	0	0	0	0	0
Carboys or Jars for oil small.	3	3	3	3	0	0	0	0	0
Cases packing large, with clamps, hinges, lock and keys..........	2	2 for package of Cartridges.							
Chalk..................lbs	3	3	3	3	0	0	0	0	0
Chains retreating sets......	0	0	0	0	1	1	1	1	1
Charcoal...........bushels.	2	2	2	2	0	0	0	0	0
Chest laboratory..........	0	0	1	1	0	0	0	0	0
„ Arm with clamps, hinges, lock & key.	1	1	1	1	for package of cartridge boxes, &c.				
Chisels of sizes..............	four with the Park.								
Cloth white punjam, pieces 70 cub..........	1	1	1	1	0	0	0	0	0
„ waxed.... ..cub.	6	6	6	6	1/9	1/9	1/9	1/9	1/9
„ canvas powder...	1	1	1	1	0	0	0	0	0
Coins wooden..........sets	3	3	3	2	when elevating screws are not provided.				
Coir or junk for wads, candies	One wad per round.								
Collars leather bullock......	46	36	0	0	0	0	0	0	0
„ „ for transporting Carriages.	6	6	including ½ spare.						
„ „ for Platform.. „ „ for Carts.....	3 to 1 Cart.								
Colors camp large with staves	6 with the park.								
Compasses brass calibre....	1	1	1	1	1	1	1	1	1
„ common iron......	1	1	1	1	0	0	0	0	0
„ iron calibre large.	One to two Brigades of heavy ordnance.								
Copper bolt............lbs.	11	11	0	0	0	0	0	0	0
„ sheet..........lbs.	10	10	6	6	0	0	0	0	0
Crows iron................	4	4	3	2	0	0	0	0	0
Cylinder Tin for Mortars...	0	0	1	1	0	0	0	0	0
Drags iron for heavy field ordnance..........	1	1	0	0	0	0	0	0	0
Drivers and setters wooden pairs........ ...	0	0	3	3	1	1	1	1	1
„ Brass cooper......	One to a Brigade heavy Ordnance.								
Engine for tapping bouches comp.	One with the park if large.								

	Heavy Field Ordnance.				Light Field Ordnance.				
	Guns.		Mortars.		Guns.		Howitzers.		
	18 Pdr.	12 Pdr.	8 in.	5½ in.	9 Pdr.	6 Pdr.	24 Pdr.	5½ in.	12 Pdr
Stores.									
Engine fuze	One to a Brigade of Mortars.								
„ for tap. wood screws	One with the Park.								
Esses iron	4	4	3	2	2	2	2	2	2
Fellies for Carriage wheels.	6	6	0	0	2	2	4	4	4
„ for platform cart „ for Mortar	2 to one Cart.								
„ for transporting carriage wheels	2 to one Carriage.								
Files 3 square for saws	1	1	1	1	0	0	0	0	0
„ of sorts	12	12	6	6	0	0	0	0	0
Fishes gun with staves	One to 2 Brigade of heavy Guns.								
Flags park with staves com.	One with the Park.								
„ gun	3 with the Park.								
Formers cartridge gun	1	1	1	1	1	1	1	1	1
Funnel copper or tin	1	1	1	1	1	1	1	1	1
Gauges iron high and low	One set with the Park.								
„ wooden for wads.	2	2	0	0	0	0	0	0	0
Gins complete with 1 spare fall	One to four heavy pieces Ordnance if the park is large.								
Glasses perspective	2 with the Park.								
Glue lbs.	1	1	1	1	0	0	0	0	0
Grease „	10	10	6	4	0	0	0	0	0
Grates for heating shot with carriers rakes, &c. complete	One with the Park.								
Gunny thick pieces.	10	8	6	4	0	0	0	0	0
Hammers claw	2	2	2	2	2	2	3	3	3
„ sledge	2	2	2	2	0	0	0	0	0
„ hand	2	2	2	2	0	0	0	0	0
Handspikes traversing	3	3	0	0	1	1	1	1	1
„ purchasing	10	10	6	6	2	2	4	4	4
Haversacks leather Gun	4	4	0	0	2	2	3	3	3
Heads rammer common	2	2	0	0	1	1	1	1	1
„ „ concave	1	1	0	0	0	0	0	0	0
„ sponge	2	2	0	0	0	0	0	0	0
Helves for mamoties &c. and spare	10	10	6	6	0	0	0	0	0
Hooks bill	6	6	6	6	2	2	3	3	3
„ copper spare	$\frac{1}{10}$ the number of powder barrels.								
„ washer	1	1	0	0	1	1	1	1	1
Husks paddy, parrah	½	½	½	½	0	0	0	0	0
Instruments for S. C.S. ~~parrah~~	One case of Instrument with Park.								
Irons priming	4	4	2	2	2	2	2	2	2
„ beak	One to a Brigade of heavy ordnance.								
„ bolt lbs.	28	28	14	10	0	0	0	0	0
„ flat „	56	56	20	15	0	0	0	0	0

	HEAVY FIELD ORDNANCE.				LIGHT FIELD ORDNANCE.				
	Guns.		Mortars.		Guns.		Howitzers.		
	18 Pdr.	12 Pdr.	8 in.	5½ in.	9 Pdr.	6 Pdr.	24 Pdr.	5½ Pdr.	12 Pdr.
STORES.									
Iron square............lbs.	28	28	14	10	0	0	0	0	0
„ rod............ „	28	28	10	10	0	0	0	0	0
„ hoop .... „	14	14	7	4	0	0	0	0	0
„ old .... „	200	200	100	50	0	0	0	0	0
Jacks hand...............	One to a Brigade heavy ordnance.								
Keys and rings for carriages spare..............	4	4	2	2	0	0	0	0	0
Knives laboratory..........	2	2	2	2	1	1	1	1	1
Ladles copper with worm....	2	2	0	0	0	0	0	0	0
„ iron dipping.... „ iron melting....	One with the Park.								
Lanthorn horn or muscovy „ dark...........	One to a Brigade heavy ordnance.								
Leather country......hides.	2	2	2	2	0	0	0	0	0
Lead white.............lbs	20	20	20	10	0	0	0	0	0
„ red............... „	1	1	1	½	0	0	0	0	0
Linstocks with cocks.......	2	2	1	1	1	1	1	1	1
Line hamborough....skeins	1	1	1	1	0	0	0	0	0
„ log	2	2	2	2	0	0	0	0	0
„ mer.................	1	1	1	1	0	0	0	0	0
„ deep sea.............	1	1	1	1	0	0	0	0	0
Locks iron pad and keys....	3	3	0	0	10	7	12	12	12
„ brass „ „	0	0	1	1	Laboratory chests.				
Machine drill for bouching gun complete.....	0	0	0	1	with Park.				
Mamoties with helves......	6	6	6	6	2	2	3	3	3
Measures cop. powder, sets for liquids .... from Gal. to gill	One of each to accompany the Park.								
Nails iron tire..........lbs.	2	2	1	½	0	0	0	0	0
„ iron sorts......lbs.	20	20	15	10	0	0	0	0	0
„ copper „ ..lbs.	1	1	1	½	0	0	0	0	0
Naves wooden for wheels..	One to a Brigade heavy Ordnance and 1 to 6 platform carts.								
Needles gunny...........	10	10	6	6	0	0	0	0	0
„ sail...............	5	5	3	3	0	0	0	0	0
„ sewing...........	25	25	25	25	0	0	0	0	0
Nets coir for wads..........	2	2	0	0	0	0	0	0	0
Oakum.. .... lbs.	200	200	150	100	60	60	57	57	66
Oil cocoanut...........gals.	2	2	2	1	0	0	0	0	0
„ linseed............. „	2	2	1	½	0	0	0	0	0
„ common.... ..... „	1	1	½	¼	0	0	0	0	0
Paint white mixed.....lbs.	10	10	5	2	0	0	0	0	0
„ blue „ ...... „	20	20	10	10	0	0	0	0	0
Palms steel hand..........	1	1	1	1	0	0	0	0	0
Pegs tent......	200	200	150	100	0	0	0	0	0

	HEAVY FIELD ORDNANCE.				LIGHT FIELD ORDNANCE.				
	Guns.		Mortars.		Guns.		Howitzers.		
	18 Pdr.	12 Pdr.	8 Pdr.	5½ Pdr.	9 Pdr.	6 Pdr.	24 Pdr.	5½ in.	12 Pdr.
STORES.									
Perpendicular spirit.	1	1	1	1	0	0	0	0	0
Pickets park.	30 with the Park.								
„ platform..........	8	8	6	6	0	0	0	0	0
Pincers brass fuze pairs.....	0	0	1	1	1	1	1	1	1
„ iron „ „	0	0	1	1	1	1	1	1	1
„ „ tube „	1	1	0	0	0	0	0	0	0
„ „ common „	2	2	2	1	1	1	1	1	1
Pin linch spare.............	10	10	0	0	0	0	0	0	0
„ iron yoke spare.........	2	2	0	0	0	0	0	0	0
Platform gun and mortar....	1	1	1	1	0	0	0	0	0
Platescrews with taps large..	1	1	1	1	0	0	0	0	0
„ „ „ small...	1	1	1	1	0	0	0	0	0
Polebars for Horse Artillery.	0	0	0	0	3	3	3	3	3
Pouches priming..........	3	3	0	0	2	2	3	3	3
Punches shell	0	0	2	2	0	0	0	0	0
„ tube...........	1	1	0	0	1	1	1	1	1
Quadrant in cases...........	One to a Brigade heavy Ordnance 1 to each Mortar.								
Rammers earth..............	10	10	10	10	0	0	0	0	0
Rasps fuze	0	0	4	4	1	1	1	1	1
„ wood	2	2	1	1	1	1	1	1	1
Reels camp with line.......	1	1	1	1	0	0	0	0	0
Relievers for spring spikes..	1	1	0	0	1	1	1	1	1
Rivets copper ....lbs.	5	5	4	3	0	0	0	0	0
Rods measuring 10 feet......	1	1	0	0	0	0	0	0	0
„ „ 5 „	1	1	1	1	0	0	0	0	0
„ „ 3 „	1	1	1	1	0	0	0	0	0
Rollers for carriage	1	1	0	0	0	0	0	0	0
Rope Europe 4½ in coils.....	1 to a Brigade of heavy Ordnance.								
„ „ 3 „ „	1 to a Brigade of heavy Ordnance.								
„ „ 2 „ „	1	1	½	½	0	0	0	0	0
„ „ 1½ „ „	1	1	1	¼	6	5	5	5	5
„ „ 1 „ „	½	½		½	0	0	0	0	0
„ „ ratline........	½	½	¼	½	0	0	0	0	0
„ Country 2 inches coils..	2	2	1	1	Exclusive to the lashing of Bandy, &c.				
„ „ 1½ „ „	3	3	2	2					
„ drag.... ....sets.	3	3	0	0	2	2	3	3	3
Rosin..................lbs.	1	1	1	1	0	0	0	0	0
Rubbers file...............	2	2	1	1	0	0	0	0	0
Rulers in cases.............	One to a Brigade of heavy Odnance.								
Salamoniac...... ......lbs.	1	1	1	½	1	0	0	0	0
Saws pit..................	One of each with the Park.								
„ cross cut....									
„ whip.................									
„ hand..................									
„ fuze..................	0	0	1	1	1	1	1	1	1

	Heavy Field. Ordnance.				Light Field Ordnance.				
	Guns.		Mortars.		Guns.		Howitzers.		
	18 Pdr.	12 Pdr.	8 in.	5½ in.	9 Pdr.	6 Pdr.	24 Pdr.	5½ in.	12 Pdr.
Stores.									
Scales wooden large with triangle complete.....	One with the Park.								
„ copper „ „ pairs.	One to a Brigade of heavy Guns and Mortars.								
„ „ small	One to each Brigade of Ordnance.								
„ Gunters...............	1	1	1	1	1	1	1	1	1
Scissors laboratory....pairs.	1	1	1	1	1	1	1	1	1
Scrapers shell..............	0	0	2	2	0	0	0	0	0
„ gun...............	1	1	1	1	1	1	1	1	1
Screws for wood......dozen.	5	5	3	2	0	0	0	0	0
Searchers with relievers.....	One of each calibre with Park.								
Sinnet for spunges......balls.	2	2	0	0	0	0	0	0	0
Serge flannel..........pieces	½	½	½	¼	0	0	0	0	0
„ coloured........ „	½	½	¼	⅛	0	0	0	0	0
Setters steel for saws........	1	1	1	1	0	0	0	0	0
Shears tinmans........pairs.	One with Park.								
Shovels....................	2	2	2	2	0	0	0	0	0
Sieves powder double........	Two with the Park.								
Skins sheep................	10	10	10	10	0	0	0	0	0
„ sheep untanned.....	0	0	1	1	0	0	0	0	0
Solder copper...........lbs.	1½	15	1	¾	0	0	0	0	0
„ pewter..............	5	½	3	2	0	0	0	0	0
Spades.....................	2	2	2	2	0	0	0	0	0
Spirits of wine..quart bottles.	1 to a Brigade of Mortars.								
„ of turpentine.. quart bottles.	1	1	½	½	0	0	0	0	0
Spikes gun of sorts..........	3	3	0	0	3	3	3	3	3
Spokes for carriage wheels..	6	6	0	0	2	2	4	4	4
„ for mortar cart......	Two to each cart or carriage.								
„ for platform „ wheels.									
„ for transport car. „									
Spunges com. gun and mortar	4	4	2	2	2	2	3	3	3
Spunyarn..............rolls.	10	10	5	5	1	1	2	2	2
Staves spunge spare........	2	2	1	1	0	0	0	0	0
Steel...................lbs	28	28	28	10	0	0	0	0	0
Sticks for signal rockets.....	1 to each rocket.								
Stocks portfire...............	1	1	0	0	1	1	1	1	1
Stones grinding with trough.	One of each with Park.								
„ oil turkey complete..									
Swivels Horse Artillery with linking chain....	0	0	0	0	2	2	3	3	3
„ with bands of Foot Artillery........	0	0	0	0	3	2	4	4	4
Tacks copper spunge....lbs.	2	2	0	0	0	0	0	0	0
„ iron „ „	2	2	0	0	0	0	0	0	0
Tar and grease........kegs.	2	2	0	0	1	1	2	2	2
„ 1 keg to 1 mortar cart &	6 Platform carts.								

	Heavy Field Ordnance.				Light Field Ordnance.				
	Guns.		Mortars.		Guns.		Howitzers.		
Stores.	18 Pdr.	12 Pdr.	8 in.	5½ in.	9 Pdr.	6 Pdr.	24 Pdr.	5½ in.	12 Pdr.
Tarpaulins large magazine..	At the rate of 4 large and 8 small magazine Tarpaul to 200-45lb. bar. Powder.								
„ small............									
„ cart or waggon..	0	0	0	0	1	1	2	2	2
„ limber...........	1	1	0	0	2	2	3	3	3
Thread cotton............lbs.	5	5	4	3	0	0	0	0	0
Thread silk...............oz.	0	0	1	1	0	0	0	0	0
Ticken...............pieces.	1 with Brigade heavy Ordnance.								
Timber teaksheathing boards	2	2	0	0	Load for a single Bandy.		17 cubic feet and 2 sheath boards.		
„ „ cubic feet......	17	17	10	7					
Tin double...........sheets	2	2	2	0	0	0	0	0	0
Tin single.......	3	3	3	1	0	0	0	0	0
Traces iron chain waggon....	0	0	0	0	1	1	2	2	2
„ „ „ mortar cart.	One to each Cart.								
„ „ „ platform. .									
„ „ „ artificers. ..									
Traces iron chain gun.......	1	1	0	0	1	1	1	1	1
„ „ „ transport	1	1	0	0	0	0	0	0	0
Twine country.........skein.	5	5	5	3	0	0	0	0	0
„ Europe........ „	2	2	2	1	2	2	2	2	2
„ gunny............lbs.	10	10	6	4	0	0	0	0	0
Vices brass cooper..........	One to a Brigade heavy ordnance.								
Vices iron bench...........	2	2	2	2	1	1	1	1	1
„ „ hand.............	1	1	1	1	0	0	0	0	0
„ „ standing.........	One to three Brigades heavy Ordnance.								
Vittery............pieces..	One to a Brigade heavy Ordnance.								
Wads gun.....	1000	1200	0	0	0	0	0	0	0
Waggons ammunition......	0	0	0	0	1½	1	2	2	2
Washer's iron spare.........	Two to each car. and platform cart.								
Wax, bees..............lbs.	0	0	0	0	0	0	0	0	0
Weights iron........ 56 lbs.	Ten with the Park.								
„ „ .... 28 „	One to a Brigade heavy Ordnance.								
„ „ .... 4 „									
„ „ .... 1 „									
Wheels for carriages spare..	2 to 6 heavy &light field car. waggons & carts								
Worms...........	0	0	0	0	1	1	1	1	1
Wrenches for screw nuts....	2	2	2	1	2	2	2	2	2
Yokes poles quadruple......	1	1	0	0	0	0	0	0	0
„ trace „	8	6	0	0	0	0	0	0	0
„ pole common.........	One to each to a platform cart ¼ spare.								
„ trace................	1	1	0	0	0	0	0	0	0
„ new muster..........	0	0	0	0	12	10	15	15	15

AVERAGE WEIGHT OF ORDNANCE AND CARRIAGES WITH SHOT AND GUNPOWDER, EXCLUSIVE OF STORES.

	ORDNANCE.					SHOT, &c.					TOTAL.	
	Ordnance.	Carriage or Bed.	Limber or Cart.	Total.	Bullocks.	No. of Rounds.	Shot.	Gunpowder with Barrels.	Total.	Bullocks.	lbs.	Bullocks.
	lbs.	lbs.	lbs.	lbs.	No.	No.	lbs.	lbs.	lbs.	No		
Iron gun 18 Pdr.	4720	2860	2048	9628	46	1025	18450	8910	27360	272	36988	318
Iron gun 12 Pdr.	3780	2550	2048	8378	36	1225	14700	7194	21894	183	36272	219
Iron mortar 8 in.	928	1400	2016	4344	14	430	17045	2508	19553	146	23897	160
Brass Mortar 5½ in.	196	464	644	1304	4	530	7736	564	8300	83	9604	87

N. B.—For weight of Howitzers and Guns, vide page 144.

FIELD BATTERIES.

In addition to the Battering train or Park, there are also Regimental Light Field Pieces.

The Horse Artillery are armed with
Brass Guns.................. 6 Pounders.
Brass Howitzers..............12 do.

The Foot Artillery are armed with
Brass Guns.................. 9 Pounders.
Brass Howitzers..............24 do.

PROPORTION OF AMMUNITION AND STORES ATTACHED TO ONE PIECE OF ORDNANCE.

	24 Pdr. Howitzer.		12 Pdr. Howitzer.		9-Pdr. Gun.		6-Pdr. Gun.	
	Howitzer with 2 waggons and limbers.	Ditto with 3 carts.	Ditto with 2 waggons and limbers.	Ditto with 3 carts.	9-Pr. gun with 1 waggon and limber.	Ditto with 2 carts	6 Ditto with 1 waggon and limber.	Ditto with 1 cart.
Shells common..........	55	51	68	60	0	0	0	0
Shot round..............	0	0	12	11	52	64	72	54
Shot canister............	19	18	23	24	40	50	54	42
Shot S. C. filled..........	17	15	38	36	14	16	18	14
Carcasses................	5	4	5	4	0	0	0	0
Total....	96	88	146	135	106	130	144	110

	24-Pdr. Howitzer.		12-Pdr. Howitzer.		9-Pdr. Gun.		6-Pdr. Gun.	
	Howitzer with 2 waggons and limbers.	Ditto with 3 carts.	Ditto with 2 waggons and limbers.	Ditto with 3 carts.	9-Pdr. gun with 1 waggon and limber.	Ditto with 2 carts.	6-Pdr. gun with 1 waggon and limber.	Ditto with 1 carts.
Axes pick with helves....	3	1	3	1	2	1	2	1
Auger fuze hand and brace	2	2	2	2	2	2	2	2
Bits gun steel............	2	2	2	2	2	2	2	2
Bill hooks.	3	1	3	1	2	1	2	1
Boxes, dredging with 1 lb. m. p...........	1	1	1	1	1	1	1	1
„ quick match 1 skein	1	1	1	1	1	1	1	1
„ copper limber......	3	1	3	1	2	1	2	1
„ Wag or cart.......	6	9	6	9	3	6	3	3
„ fuze with 30 S. C. fuzes......	1	1	1	1	1	1	1	1
Buckets tar.....	2	1	2	1	1	1	1	1
„ water.	1	1	1	1	1	1	1	1
Cartridges serge filled....	96	88	164	141	114	140	185	132
„ cloth bursting C. S.	55	51	68	60	0	0	0	0
„ „ „ S. C. S.	17	15	38	36	14	16	18	14
„ serge empty..	9	12	18	18	16	20	20	10
Copper bottle with spirits of wine.....	1	1	1	1	1	1	1	1
Chains retreating.. sets..	1	1	1	1	1	1	1	1
„ linking..........	3	0	3	0	2	0	2	0
Compasses common......	1	1	1	1	1	1	1	1
„ calibre........	1	1	1	1	1	1	1	1
Driver and setter........	1	1	1	1	1	1	1	1
Esses......	2	2	2	2	2	2	2	2
Felloes.......	4	3	4	3	2	2	2	1
Fuzes common...........	76	72	88	76	0	0	0	0
„ S. C. S............	0	0	20	24	0	0	0	0
Funnel copper.....	1	1	1	1	1	1	1	1
Hammers claw....	3	1	3	1	2	1	2	1
Haversacks.	3	1	3	1	2	1	2	1
Handspikes common.....	4	3	4	3	2	2	2	1
Knife......	1	1	1	1	1	1	1	1
Linstock.....	1	1	1	1	1	1	1	1
Lock pad with keys......	12	11	12	11	7	8	7	5
Match cotton skeins......	2½	1½	2½	1½	3	2	3	2
Mamoties.......	3	1	3	1	2	1	2	1
Oakum.............lbs..	57	61	66	64	60	75	60	45
Pincers brass fuze.......	1	1	1	1	1	1	1	1
„ „ common....	1	1	1	1	1	1	1	1

	24-Pdr. Howitzer.		12 Pdr. Howitzer.		9-Pdr. Gun.		6 Pdr. Gun.	
	Howitzer with 2 waggons and limbers.	Ditto with 3 carts.	Howitzer with 2 waggons and limber.	Ditto with 3 carts.	9-Pdr. gun with 1 waggon and limber.	Ditto with 2 carts.	6-Pdr. gun with 1 waggons and 1 limber.	Ditto with 1 cart.
Portfires	40	38	40	38	30	32	60	50
„ stocks	1	1	1	1	1	1	1	1
Pouch priming with 1lb. S. G.	3	1	3	1	2	1	2	1
Pole bar Horse Artillery	5	0	5	0	3	0	3	0
Priming irons	2	2	2	2	2	2	2	2
Punch tube	1	1	1	1	1	1	1	1
Rasp fuze	1	1	1	1	1	1	1	1
Ropes drag. ... setts	3	1	3	1	2	1	2	1
Rope Europe 1½ in fathom	24	36	48	36	24	24	24	12
Saw fuze	1	1	1	1	1	1	1	1
Scissors	1	1	1	1	1	1	1	1
Scale gunters	1	1	1	1	1	1	1	1
Spikes spring	1	1	1	1	1	1	1	1
„ ragged	1	1	1	1	1	1	1	1
„ round	1	1	1	1	1	1	1	1
„ reliever	1	1	1	1	1	1	1	1
Spunyarn......rolls.	2	1½	2	1½	1	1	1	½
Spunges	3	3	3	3	2	3	2	2
Spokes	4	3	4	3	2	2	2	1
Swivels Horse Artillery	5	0	5	0	3	0	3	0
„ foot Artillery with bands	0	5	0	5	0	3	0	2
Tarpaulins	5	4	5	4	3	3	3	2
Tar and grease kegs filled.	2	3	2	3	1	2	1	1
Traces chain....setts	0	4	0	4	0	3	0	2
Twine Europe...skeins	2	2	2	2	2	2	2	2
Vice bench	1	1	1	1	1	1	1	1
Wax cloth ......cubits	2	2	2	2	2	2	2	2
Wrench	2	1	2	1	2	1	2	1
Worms	1	1	1	1	1	1	1	1
Yokes	0	11	0	10	0	9	0	6
„ spare	0	2	0	2	0	2	0	2

MODE OF STOWING AMMUNITION 24-POUNDER HOWITZER.

			24 Pounder.												
			Shot.					Cartridge							
			Shells common.	Shot canister.	Do. sph. case.	Carcasses.	Total.	Serge 2 lbs.	Cloth 12 oz.	Cloth 6 oz.	Serge empty.	Portfires.	Fuzes common.	Match cot. skein.	Oakum lbs.
Howitzer Waggon.	Limber.	Right locker.......	4	0	3	1	8	0	0	0	0	0	0	0	3½
		Copper box........	0	0	0	0	0	16	9	3	3	0	0	0	0
		Left locker.... ..	5	3	0	0	8	0	0	0	0	0	0	0	3½
		Front partition.....	0	0	0	0	0	0	0	0	0	10	12	½	0
		Total......	9	3	3	1	16	16	9	3	3	10	12	½	7
Ammunition Waggon 3 Boxes.	Near Box.	Right locker.....	4	0	0	0	4	0	0	0	0	0	0	0	3
		Copper box......	0	0	0	0	0	8	5	1	0	0	7	0	0
		Left locker......	1	2	1	o	4	0	0	0	0	0	0	0	3
	Off Box.	Right locker.....	4	0	0	0	4	0	0	0	0	0	0	0	3
		Copper box......	0	0	0	0	0	8	5	1	0	0	7	0	0
		Left locker.......	1	2	1	0	4	0	0	0	0	0	0	0	3
	Hind Box.	Right locker.....	4	0	0	0	4	0	0	0	0	0	0	0	3
		Copper box......	0	0	0	0	0	8	4	2	0	0	6	0	0
		Left locker......	0	1	2	1	4	0	0	0	0	0	0	0	3
		Total.... .	14	5	4	1	24	24	14	4	0	0	20	0	18
Total Ammunition in 2 waggons with limbers and howitzer limber......			55	19	17	5	96	96	55	17	9	30	76	12	57
Ammunition Cart 3 Boxes.	Near Box.	Right locker....	4	o	0	0	4	0	0	0	0	0	0	0	3
		Copper box.......	o	0	0	0	0	8	5	1	1	2	7	0	0
		Left locker......	1	2	1	0	4	0	0	0	0	0	0	0	3
	Off Box.	Right locker.....	4	0	0	0	4	0	0	0	0	0	0	0	3
		Copper Box......	0	0	0	0	0	8	5	1	1	2	7	0	0
		Left locker	1	2	1	0	4	0	0	0	0	0	0	0	3
	Hind Box.	Right locker.....	4	0	0	0	4	0	0	0	0	0	0	0	3
		Copper box......	0	0	0	0	0	8	4	2	1	2	6	0	0
		Left locker......	0	1	2	1	4	0	0	0	0	0	0	0	3
		Total......	14	5	4	1	24	24	14	4	3	6	20	0	18
Total Ammunition in 3 carts and howitzer limber.			51	18	15	4	88	88	15	15	12	28	72	½	61

MODE OF STOWING AMMUNITION, &c.
12-POUNDER.

		12-POUNDER.																
		SHOT.						CARTRIDGE.					FUZE.			
		Shells common.	Shot round.	Shot cannister.	Shot sph. case.	Carcasses.	Total.	Serge 1¼lb.	Cloth 8oz.	Cloth 4½oz.	Serge empty.	Portfires.	Common.	Spher. case.	Match cotton.	Oakum lbs.
Howit. or Wag. Limber.	Right Locker ..	6	1	2	3	0	12	0	0	0	0	0	0	0	0	5
	Copper Box....	0	0	0	0	0	0	30	12	6	6	0	0	0	0	0
	Left Locker....	6	1	1	3	1	12	0	0	0	0	0	0	0	0	5
	Front Partition	0	0	0	0	0	0	0	0	0	0	10	16	0	½	0
	Total....	12	2	3	6	1	24	30	12	6	6	10	16	0	½	10
Ammunition Waggon 3 Boxes. Near Box.	Right Locker..	0	0	2	4	0	6	0	0	0	0	0	0	0	0	3
	Copper Box....	0	0	0	0	0	0	12	5	4	0	0	6	4	0	0
	Left Locker....	5	1	0	0	0	6	0	0	0	0	0	0	0	0	3
Off box.	Right Locker..	0	0	3	3	0	6	0	0	0	0	0	0	0	0	3
	Copper Box...	0	0	0	0	0	0	12	5	3	0	0	6	3	0	0
	Left Locker....	5	1	0	0	0	6	0	0	0	0	0	0	0	0	3
Hind box	Right Locker ..	0	0	2	3	1	6	0	0	0	0	0	0	0	0	3
	Copper Box..	0	0	0	0	0	0	13	6	3	0	0	8	3	0	0
	Left Locker..	6	1	0	0	0	7	0	0	0	0	0	0	0	0	3
	Total..	16	3	7	10	1	37	37	16	10	0	0	20	10	0	18
Total ammunition in 2 waggons with limber and Howitzer Limber		68	12	23	38	5	146	164	68	38	18	30	88	20	1½	66
Ammunition Cart 3 Boxes. Near Box.	Right Locker..	0	0	2	4	0	6	0	0	0	0	0	0	0	0	3
	Copper Box ..	0	0	0	0	0	0	12	5	4	2	2	6	4	0	0
	Left Locker ..	5	1	0	0	0	6	0	0	0	0	0	0	0	0	3
Off Box.	Right Locker..	0	0	3	3	0	6	0	0	0	0	0	0	0	0	3
	Copper Box ..	0	0	0	0	0	0	12	5	3	2	2	6	4	0	0
	Left Locker ..	5	1	0	0	0	6	0	0	0	0	0	0	0	0	3
Hind Box.	Right Locker..	0	0	2	3	1	6	0	0	0	0	0	0	0	0	3
	Copper Box ..	0	0	0	0	0	0	13	6	3	0	2	8	0	0	0
	Left Locker ..	6	1	0	0	0	7	0	0	0	0	0	0	0	0	3
	Total....	16	3	7	10	1	37	37	16	10	4	6	20	8	0	18
Total ammunition in 3 carts and Howitzer Limber.		60	11	24	36	4	135	141	60	36	18	28	76	24	1	64

MODE OF SHOWING AMMUNITION 9-POUNDER GUN.

			Shot.				Cartridge.					
			Round.	Canister.	Spherical case.	Total.	Serge 2¼ lbs.	Cloth 3½ oz.	Empty.	Portfires.	Matchcotton skeins.	Oakum lbs.
Gun or waggon.	Limber.	Right locker.....	7	5	2	14	0	0	0	0	0	7½
		Copper box.....	0	0	0	0	32	4	8	0	0	0
		Left locker.....	7	5	2	14	0	0	0	0	0	7½
		Front partition...	0	0	0	0	0	0	0	10	1	0
		Total..	14	10	4	28	32	4	8	10	1	15
Ammunition waggon 3 boxes.	Near box.	Right locker...	4	3	1	8	0	0	0	0	0	5
		Copper box....	0	0	0	0	16	2	0	0	0	0
		Left locker.....	4	3	1	8	0	0	0	0	0	5
	Off box.	Right locker.....	4	3	1	8	0	0	0	0	0	5
		Copper box....	0	0	0	0	16	2	0	0	0	0
		Left locker.....	4	3	1	8	0	0	0	0	0	5
	Hind box.	Right locker....	4	4	1	9	0	0	0	0	0	5
		Copper box....	0	0	0	0	18	2	0	0	0	0
		Left locker.....	4	4	1	9	0	0	0	0	0	5
		Total..	24	20	6	50	50	6	0	0	0	30
Total Ammunition in waggon with limber and gun limber.			52	40	14	106	114	14	16	20	2	60
Ammunition Cart 3 boxes.	Near box.	Right locker....	4	3	1	8	0	0	0	0	0	5
		Copper box....	0	0	0	0	17	2	2	2	0	0
		Left locker	4	3	1	8	0	0	0	0	0	5
	Off box.	Right locker...	4	3	1	8	0	0	0	0	0	5
		Copper box....	0	0	0	0	18	2	2	2	0	0
		Left locker.....	5	3	1	9	0	0	0	0	0	5
	Hind box.	Right locker....	4	4	1	9	0	0	0	0	0	5
		Copper box....	0	0	0	0	19	2	2	2	0	0
		Left locker.....	4	4	1	9	0	0	0	0	0	5
		Total..	25	20	6	51	54	6	6	6	0	30
Total Ammunition in 2 carts and gun limber.			64	50	16	130	140	16	20	22	1	75

MODE OF STOWING AMMUNITION 6-POUNDER GUN.

			Shot.				Cartridges.					
			Round.	Canister.	Spherical case.	Total.	Serge 1½lbs.	Cloth 2½ oz.	Empty.	Portfires.	Match cotton skein.	Oakum lbs.
Gun or waggon.	Limber.	Right locker....	17	0	0	17	0	0	0	0	0	7½
		Copper box....	0	0	0	0	52	6	10	0	0	0
		Left locker......	3	16	0	19	0	0	0	0	0	7½
		Front partition. .	0	0	6	6	0	0	0	10	1	0
		Total..	20	16	6	42	52	6	10	10	1	15
Ammunition waggon 3 boxes.	Near box.	Right locker....	6	3	1	10	0	0	0	0	0	5
		Copper box....	0	0	0	0	27	2	0	10	0	0
		Left locker.....	5	4	1	10	0	0	0	0	0	5
	Off box.	Right locker. ...	6	3	1	10	0	0	0	0	0	5
		Copper box.....	0	0	0	0	27	2	0	10	0	0
		Left locker......	5	4	1	10	0	0	0	0	0	5
	Hind box.	Right locker. ...	5	4	1	10	0	0	0	0	0	5
		Copper box.....	0	0	0	0	27	2	0	10	0	0
		Left locker.....	5	4	1	10	0	0	0	0	0	5
		Total..	32	22	6	60	81	6	0	30	0	30
Total Ammunition in waggon with limber and gun limber.			72	54	18	144	185	18	20	50	2	60
Ammunition cart 3 boxes.	Near box.	Right locker....	6	4	2	12	0	0	0	0	0	5
		Copper box....	0	0	0	0	27	3	0	10	0	0
		Left locker.....	5	5	1	11	0	0	0	0	0	5
	Off box.	Right locker. ...	6	4	2	12	0	0	0	0	0	5
		Copper box.....	0	0	0	0	27	3	0	10	0	0
		Left locker.....	5	5	1	11	0	0	0	0	0	5
	Hind box.	Right locker. ...	6	4	1	11	0	0	0	0	0	5
		Copper box....	0	0	0	0	26	2	0	10	0	0
		Left locker.	6	4	1	11	0	0	0	0	0	5
		Total..	34	26	8	68	80	8	0	30	0	30
Total Ammunition in 1 cart and gun limber.			54	42	14	110	132	14	0	40	1	45

Lashed to the Limber.—1 sett drag ropes, 1 mamotie, 1 pick axe, 1 bill hook, a tar bucket hooked under the waggon limber, 10 portfires, 1 priming pouch, 1 haversack, 1 skein cotton match placed over the lockers—a Tarpaulin covering the box, a water bucket under the carriage.

Lashed to the Waggon.—1 spare spunge, 2 spokes, 2 felloes, 1 roll spunyarn and 2 handspikes, 1 keg tar and grease in rear of waggon—a Tarpaulin over all the boxes with 12 fathoms Europe rope.

Lashed to the Cart.—1 spare spunge, 1 spoke, 1 felloe, 1 handspike—a Tarpaulin over all the boxes with 12 fathoms Europe rope.

Stores carried with the spare Carriages attached to Troops and Companies.

	Spare carriage.	Spare waggon.	Spare ammunition cart.
Axe pick	1	1	1
Buckets water	1	0	0
Buckets tar	0	1	1
Bill hooks	1	1	1
Chains retreating ... setts	1	0	0
Chains linking ... „	1	1	0
Felloes	1	3	3
Handspikes common	1	1	0
Locks pad with keys	2	5	3
Mamotie	1	1	1
Pole limber	2	0	1
Pole ammunition cart	0	0	1
Pole bar Horse Artillery	1	1	0
Ropes drag ... setts	1	1	1
Rope Europe 1½ inch ... fathoms	0	12	12
Spunyarn ... rolls	0	1	1
Spunges	1	0	0
Spokes	0	6	3
Splinter bars	0	2	0
Swivels with bands Foot Artillery	0	0	1
Swivels „ „ Horse „	1	1	0
Tarpaulins	1	2	1
Traces chain	1	1	1
Yokes	3	3	1
Yokes spare	1	1	1

The number of guns, carriages, waggons, ammunition carts and spare carriages allowed to Regimental batteries is as follows.

HORSE ARTILLERY BATTERY.

Howitzers with carriages and Limbers	12-Pounders	2
Guns „ „ „	6 „	4
Waggons with Limbers	12 „	4
Waggons „ „	6 „	4
Carts forge		1
Carts artificers		1
Carriage with Limber spare	12 „	1
Carriage „ „ „	6 „	1
Waggon „ „ „		1

FOOT ARTILLERY BATTERY.

Howitzers with carriages and Limbers	24-Pounders	2
Guns „ „ „	9 „	6
Carts ammunition	24 „	6
Carts „	9 „	13½
Carts „ spare	24 „	1
Carts „ „	9 „	1

AVERAGE WEIGHT OF GUNS, CARRIAGES, AMMUNITIONS LIMBERS, WAGGONS AND CARTS ATTACHED TO PIECES OF ORDNANCE WITH A FIELD BATTERY.

	GUN AND CARRIAGE.					WAGGON.			CART.			
	Gun or Howitzer.	Carriage.	Limber.	Ammunition.	Total.	Waggon.	Limber.	Ammunition.	Limber.	Cart.	Ammunition.	Total.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
24-Pdr. Howt.	1120	1435	1260	438	4253	1185	1204	1058	3447	1148	580	1728
12 „ „	738	1232	1204	408	3582	1185	1204	984	3373	1148	534	1682
9 Pdr. Gun.	1120	1260	1204	438	4022	1185	1204	1166	3555	1148	687	1835
6 „ „	672	1232	1204	461	3569	1185	1204	1122	3511	1148	663	1811

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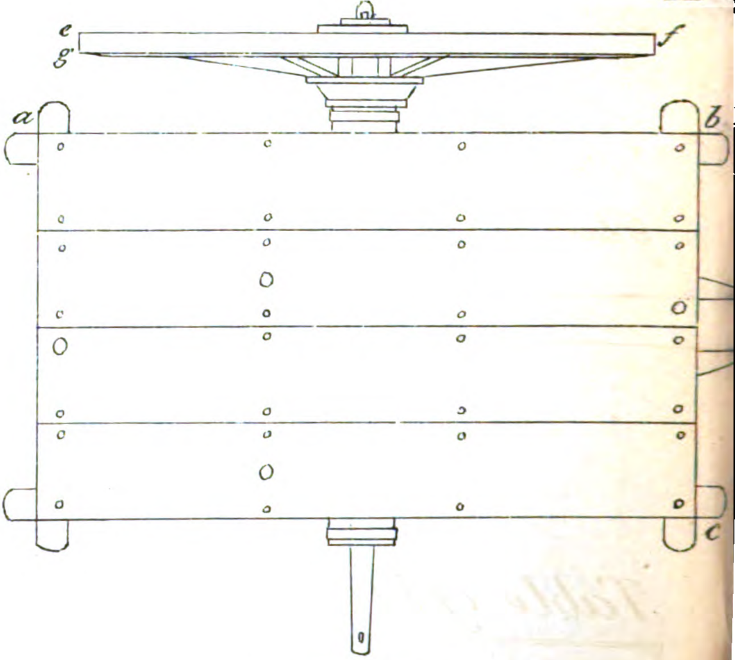
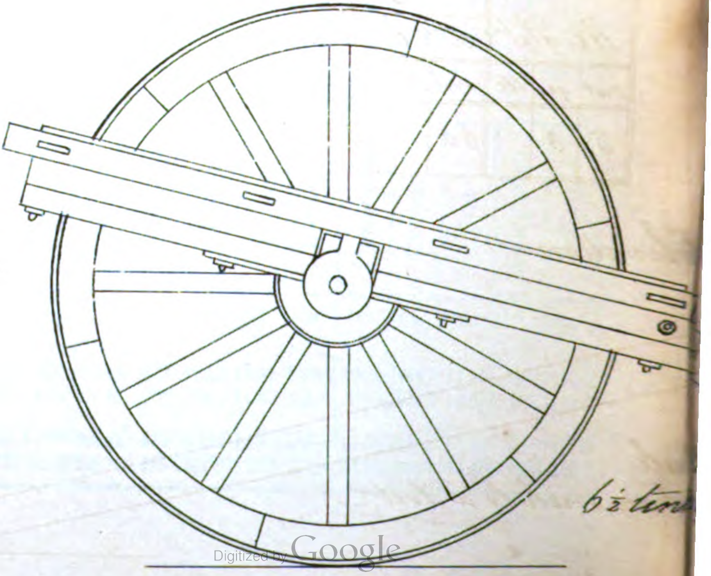




tillery.

orm Cart.

fig 40.

Plan

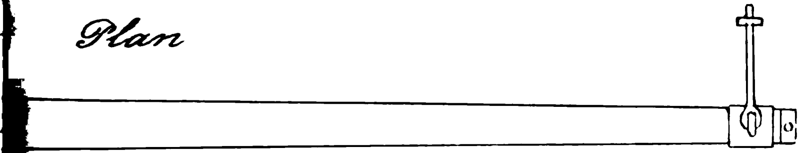
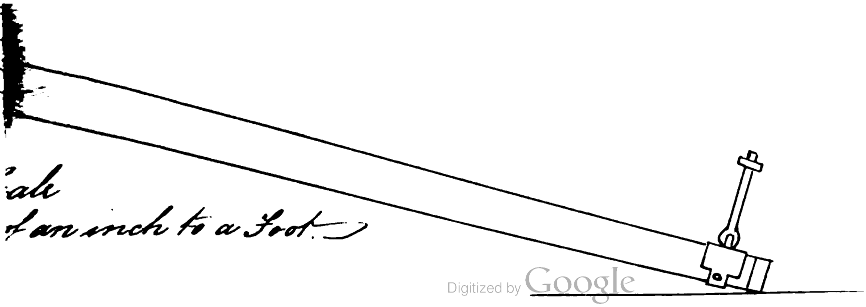


Table of Dimensions.

Weight			Length from							
			a to b		b to c		e to f		e to g	
cwt	qrs	lbs	ins	ths	ins	ths	ins	ths	ins	ths
5	3	.	60	.	36	.	54	.	2	5

levation



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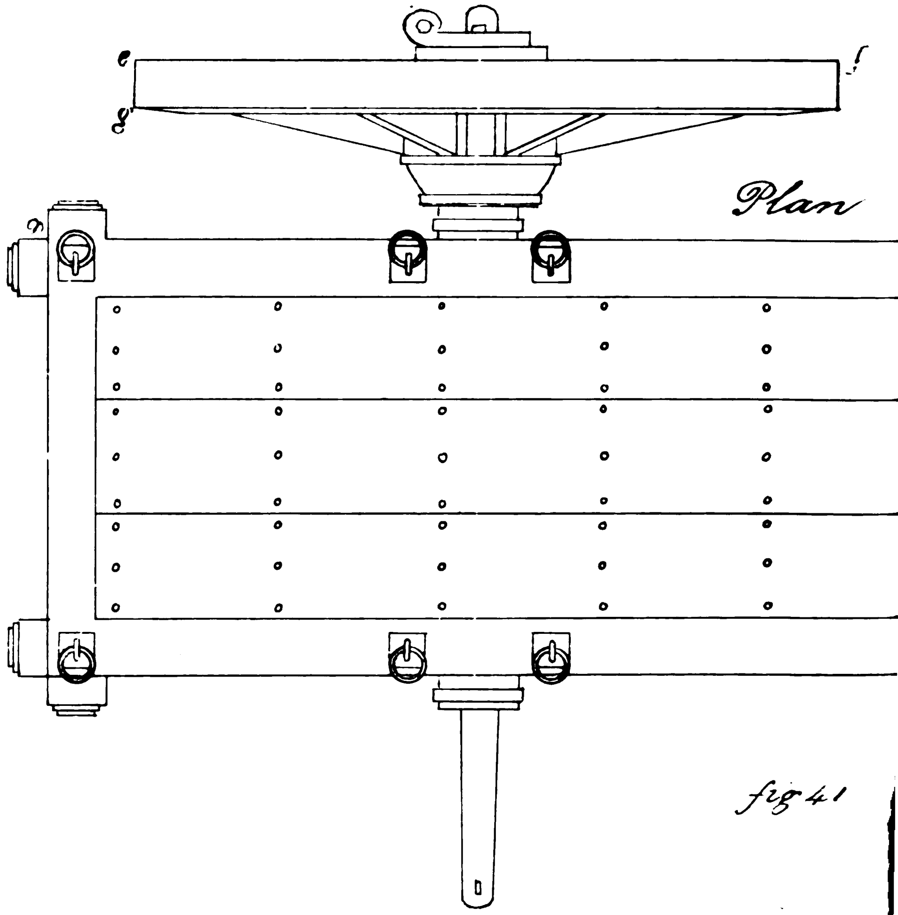
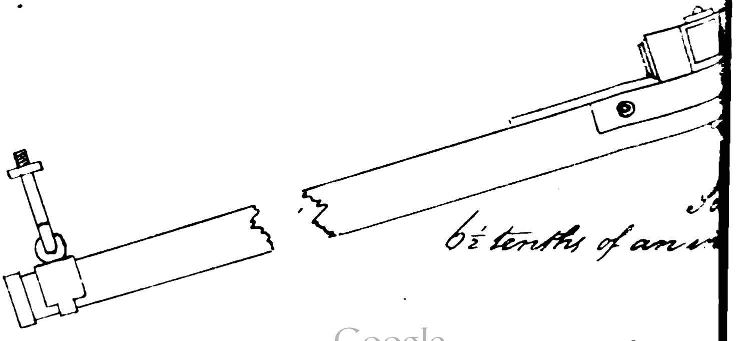
f an inch to a Foot.



Plan

fig 41

Elevation

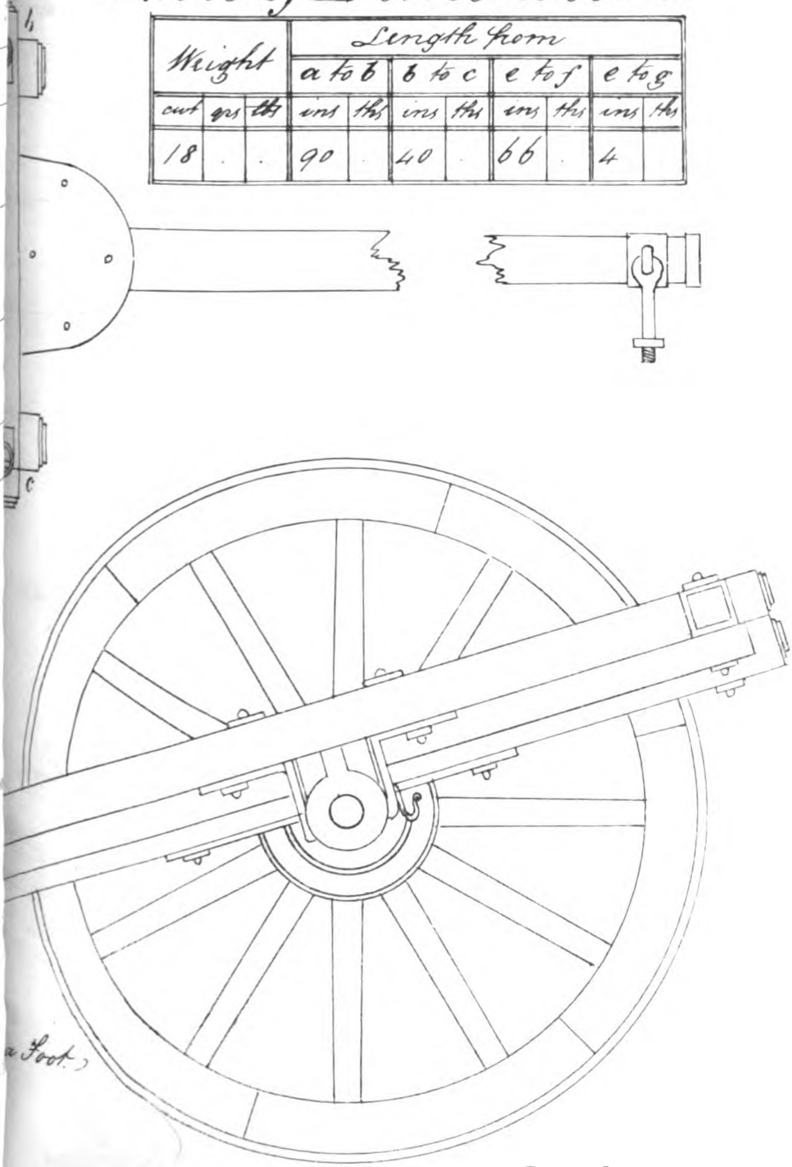


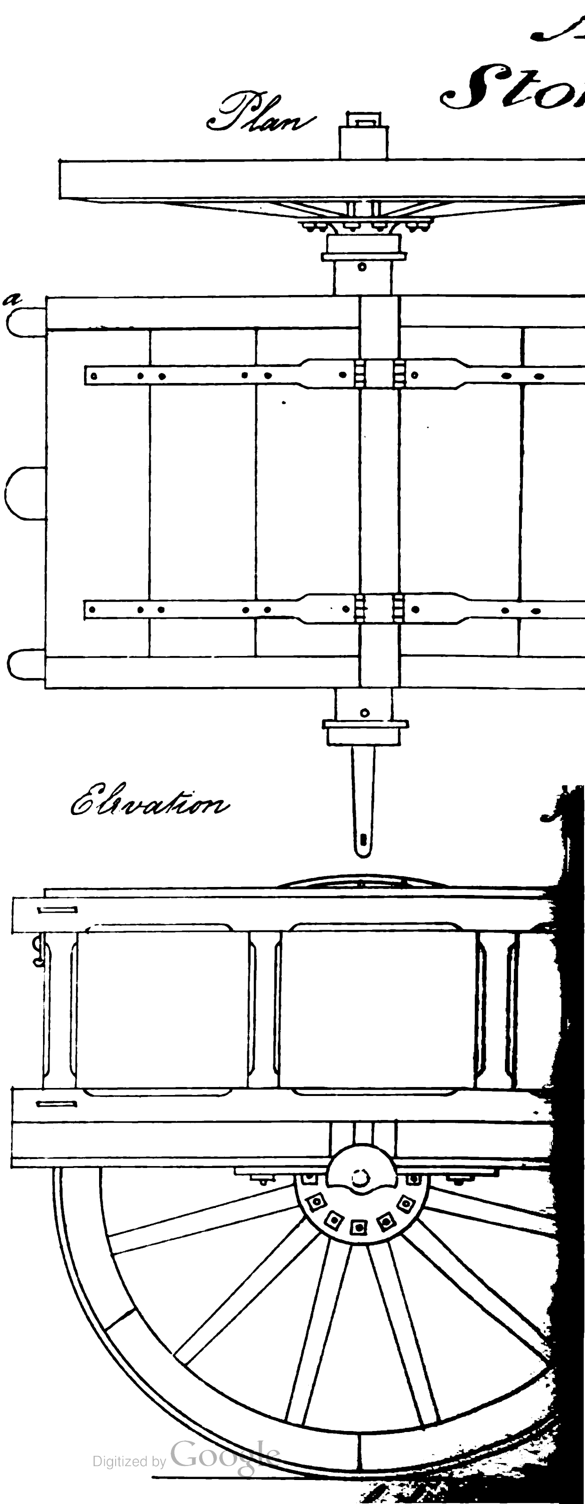
6½ tenths of an

Artillery
Mortar Cart

Table of Dimensions.

Weight			Length from							
			a to b		b to c		e to f		e to g	
cwt	qrs	lbs	ins	ths	ins	ths	ins	ths	ins	ths
18	.	.	90	.	40	.	66	.	4	




Sto
Plan
a
Elevation

illery.
Waggon.

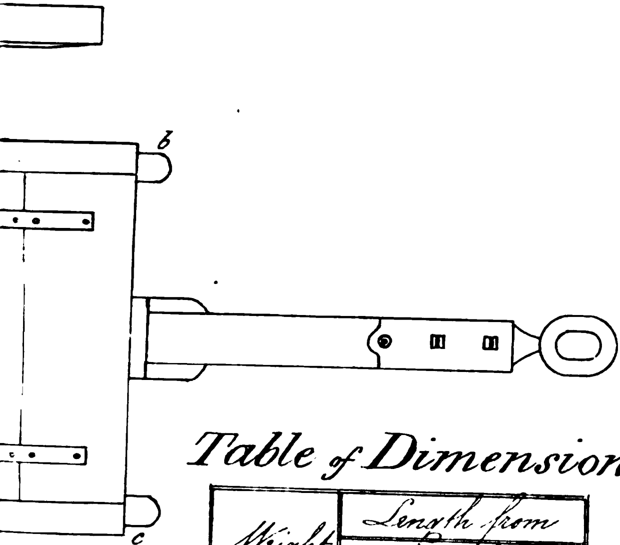
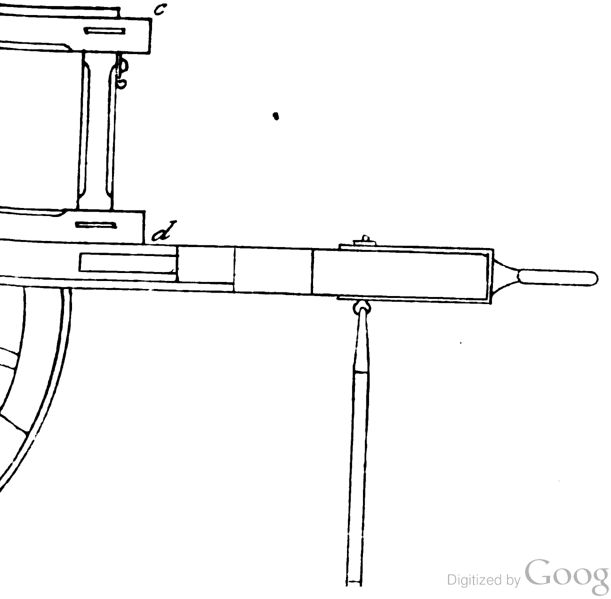


Table of Dimensions.

Weight			Length from					
			a to b.		b to c		c to d	
Cwt.	Qrs.	lbs	Ft.	in	Ft.	in.	Ft.	in
10	3	8	5	8¼	3	3	2	"

42.



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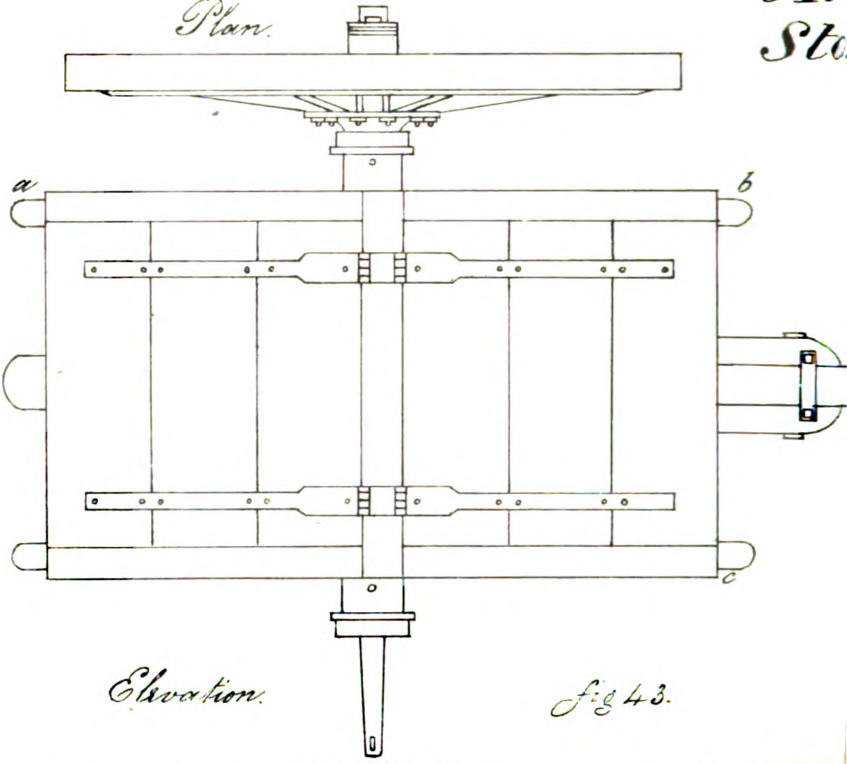
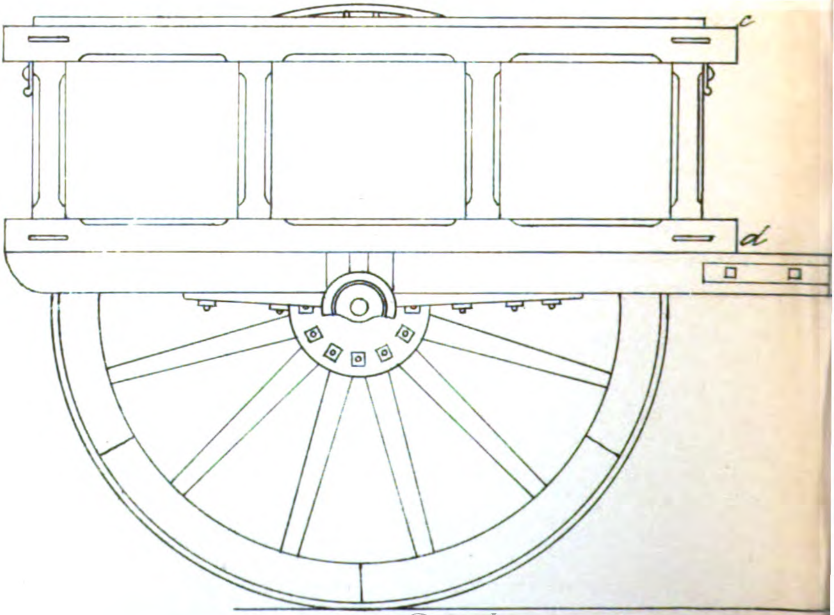
Plan.



Elevation.

Fig 43.



Scale 6½ tenths

illery
e Cart

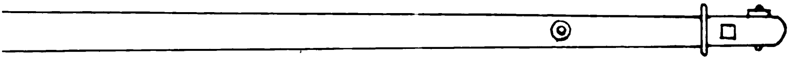
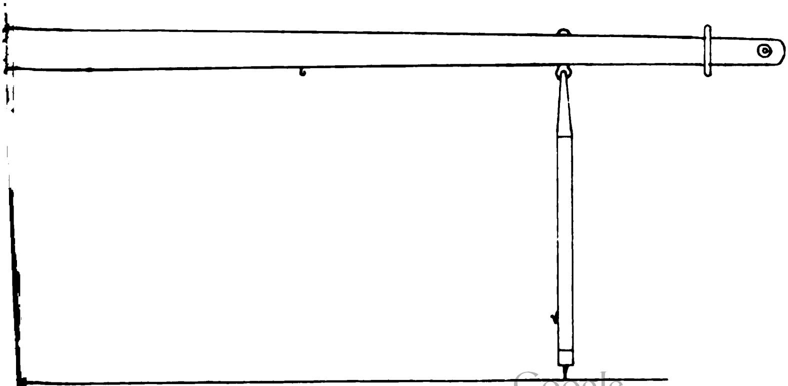


Table of Dimensions

Weight			Length from					
			a to b		b to c		c to d	
cwt	qrs	lbs	ins	ths	ins	ths	ins	ths
10	3	8	68	2½	39	..	24	.



n Inch to a Foot.

Plan

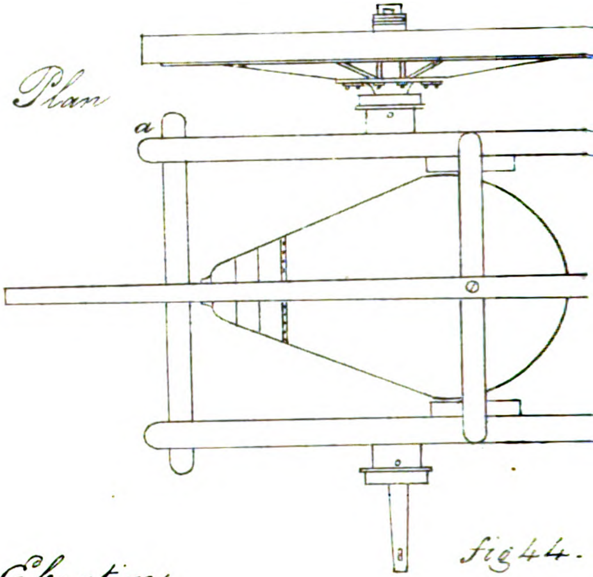
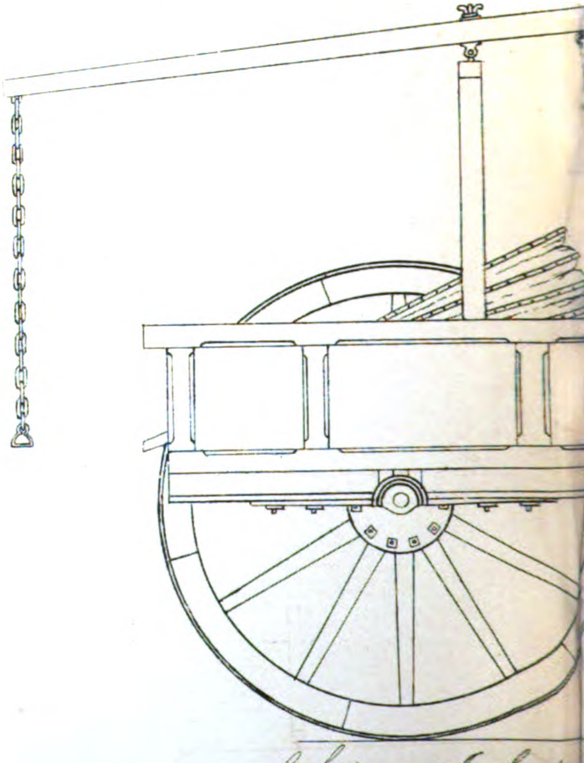


Fig 44.

Elevation.



Scale ½ an Inch to

Artillery.
Forge Waggon

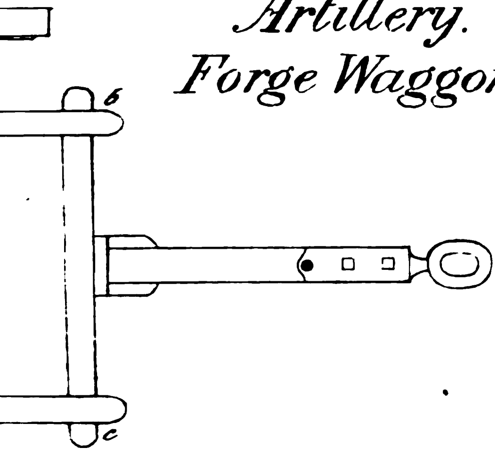
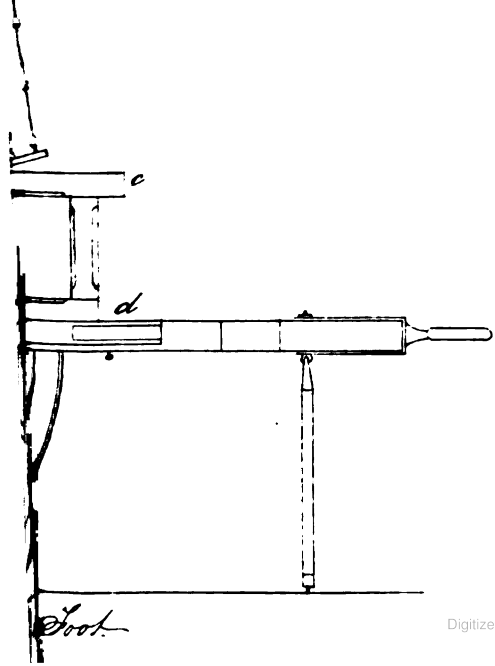


Table of Dimensions

Weight			Length from					
			a to b		b to c		c to d	
cwt.	Qrs.	lbs.	ins.	ths.	ins.	ths.	ins.	ths.
10	3	18	68	2½	39	.	18	.



Plan

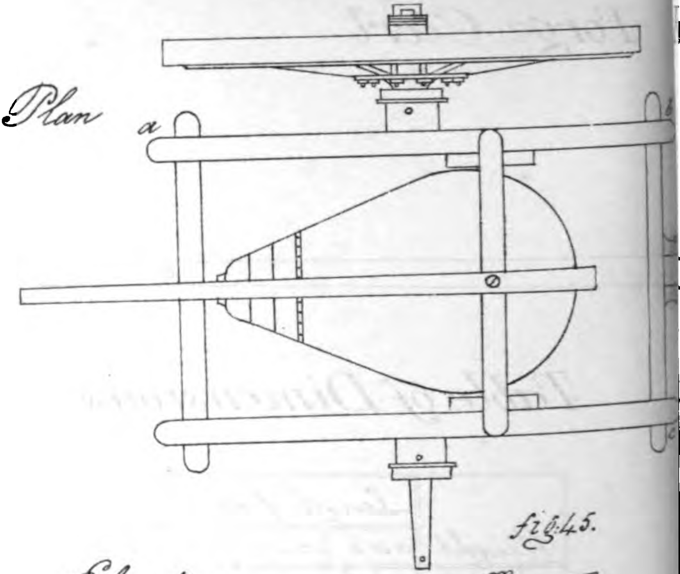
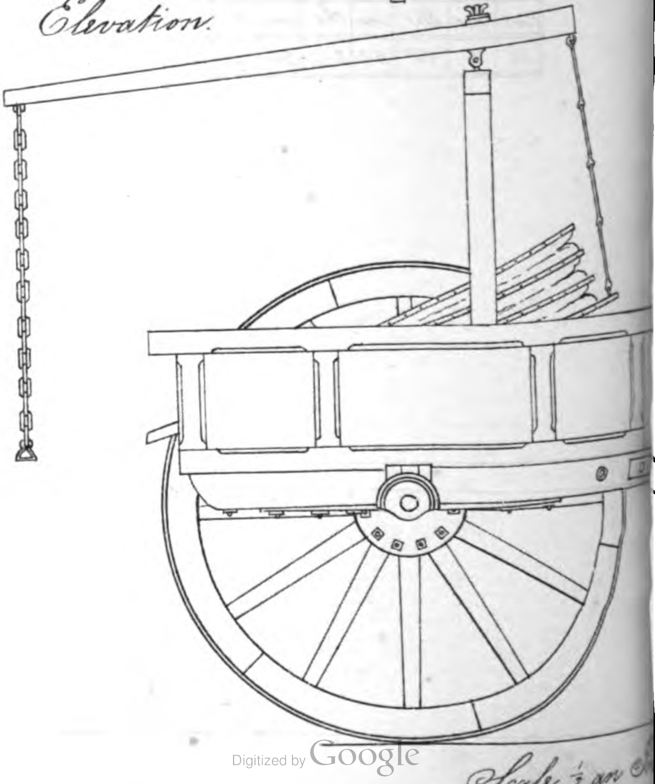


fig. 45.

Elevation.



Scale ½ an

Artillery.
Forge Cart

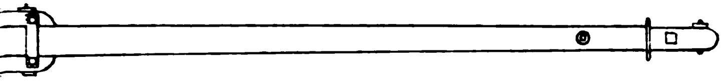
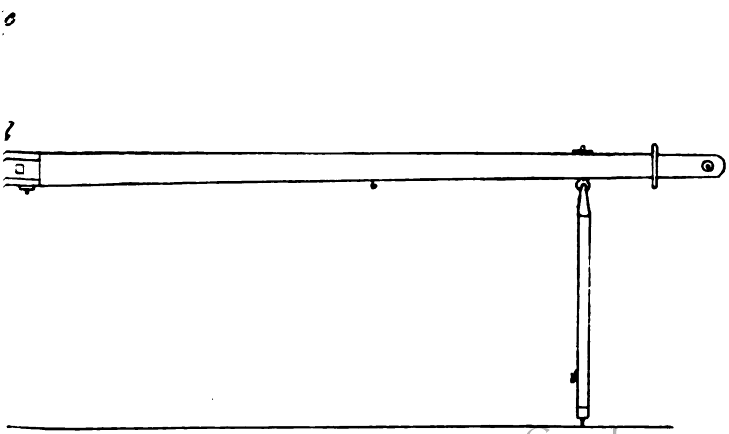


Table of Dimensions

Weight			Length from					
			a to b		b to c		c to d	
Cwt.	Qrs.	lbs.	ins.	ths.	ins.	ths.	ins.	ths.
10	3	18	68	2 ½	39	.	18	.



to a Foot.

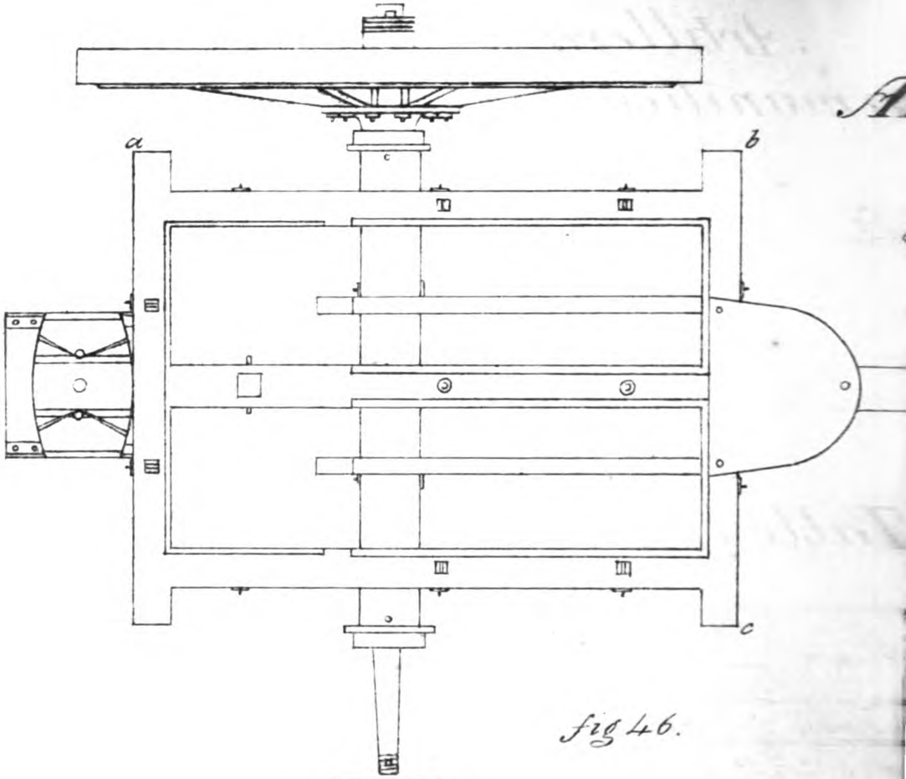
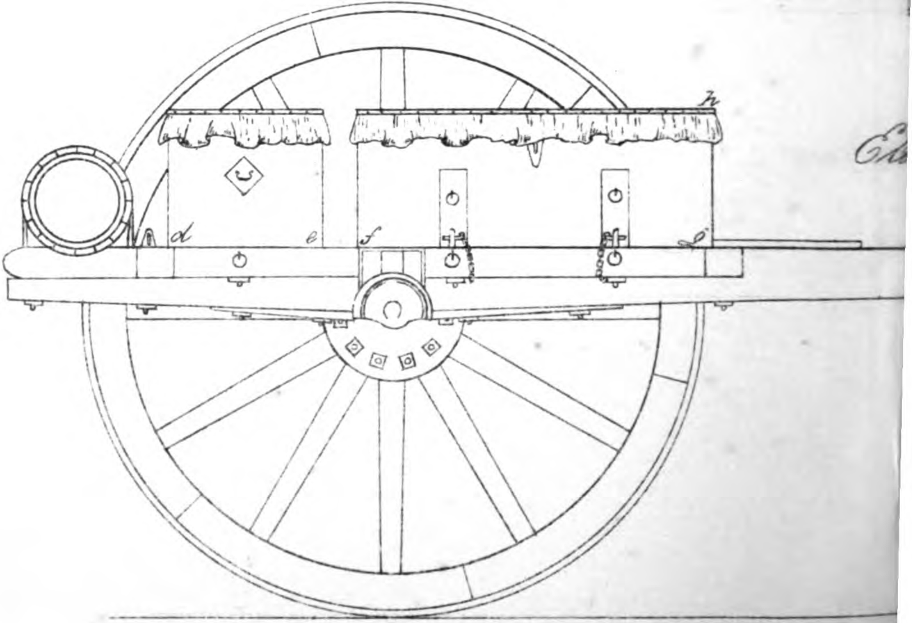


fig 46.



Scale 6½ tenths of an

Artillery.

mmunition Cart.

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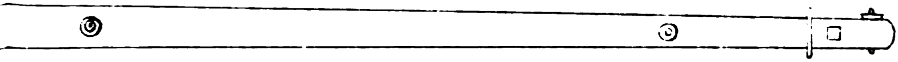
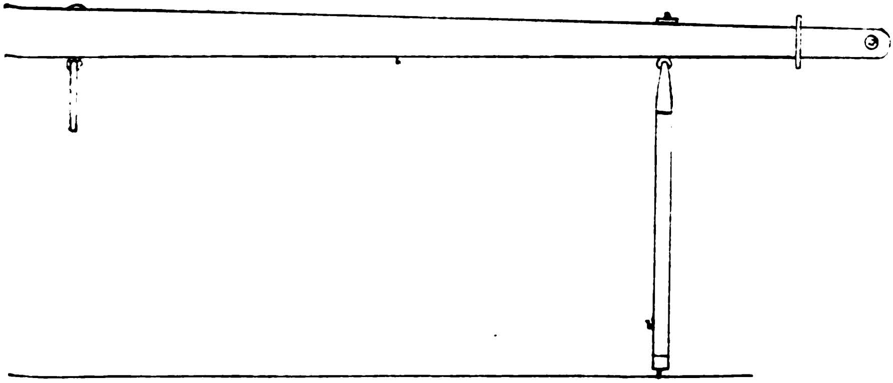


Table of Dimensions.

Weight			Length from									
			a to b		b to c		d to e		f to g		g to h	
cwt	qrs	lbs	ins	8ths	ins	8ths	ins	8ths	ins	8ths	ins	8ths
4	3	20 6/16	58	5	47	6¼	10	5	34	2½	15	2½

vation.



h to a Foot

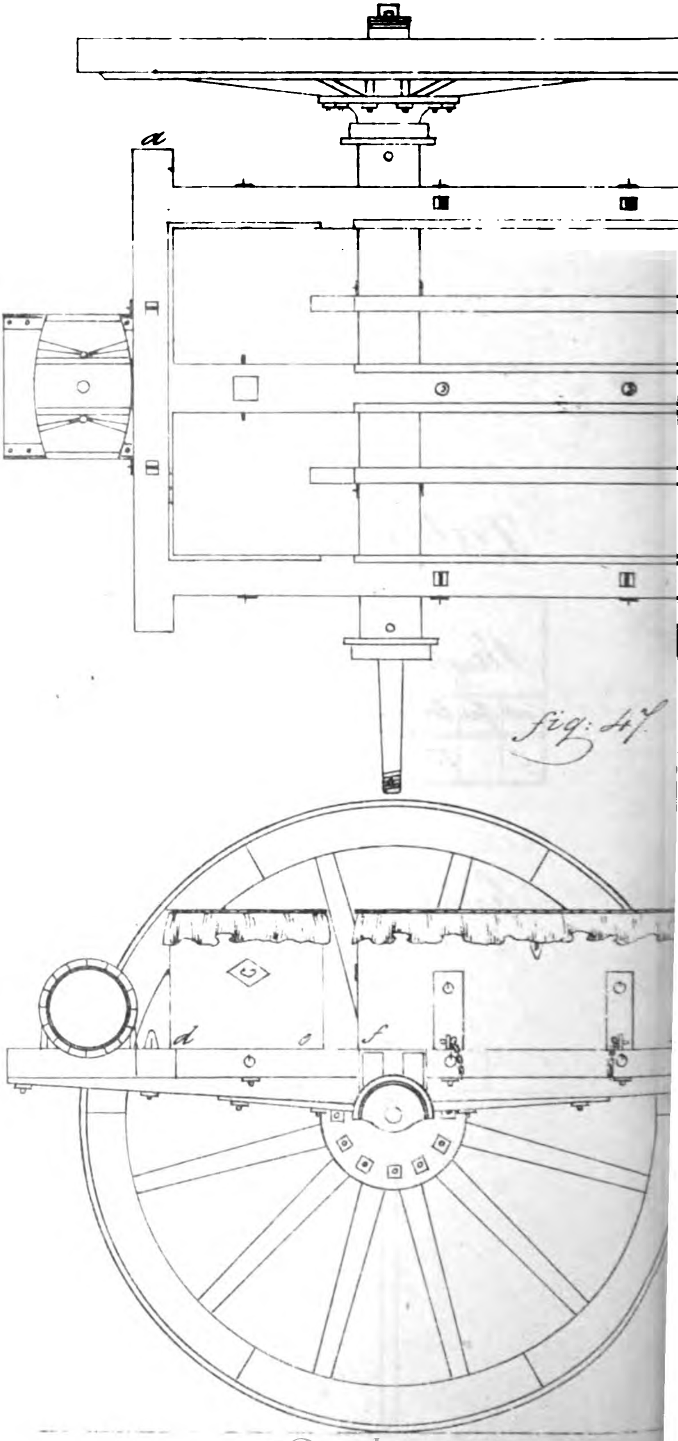


fig: 47

Scale 6 2ths. of an Inch

Artillery.
Ammunition Waggon.

Plan

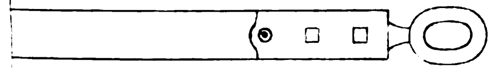
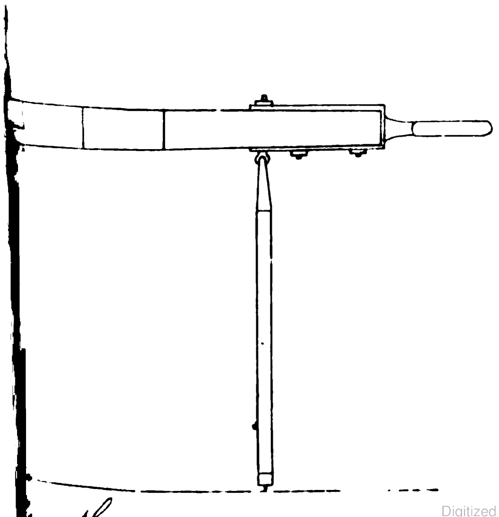


Table of Dimensions.

Weight			Length from									
			a to b		b to c		d to e		f to g		g to h	
Cwt.	Qrs.	lbs.	ins.	ths.	ins.	ths.	ins.	ths.	ins.	ths.	ins.	ths.
9	.	23	58	5	47	6¼	10	5	34	2½	15	2½

Elevation



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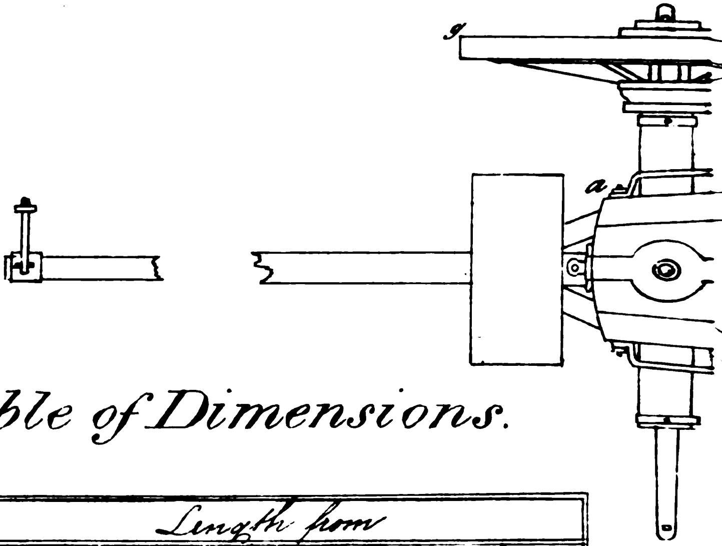
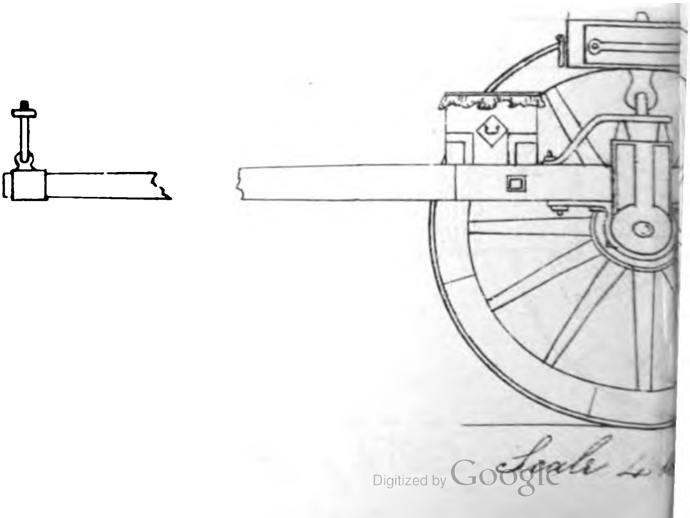


Table of Dimensions.

Weight			Length from													
			a to b.		c to d.		e to f		g to h		h to i		j to k		k to l	
cwt.	qrs.	lbs.	Feet	Ins.	Feet	Ins.	Feet	Ins.	Feet	Ins.	Feet	Ins.	Feet	Ins.	Feet	Ins.
28	1	19	12	.	4	$8\frac{1}{2}$	3	5	5	-	.	4	7	8	..	$5\frac{1}{4}$



Scale

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t Carriage.

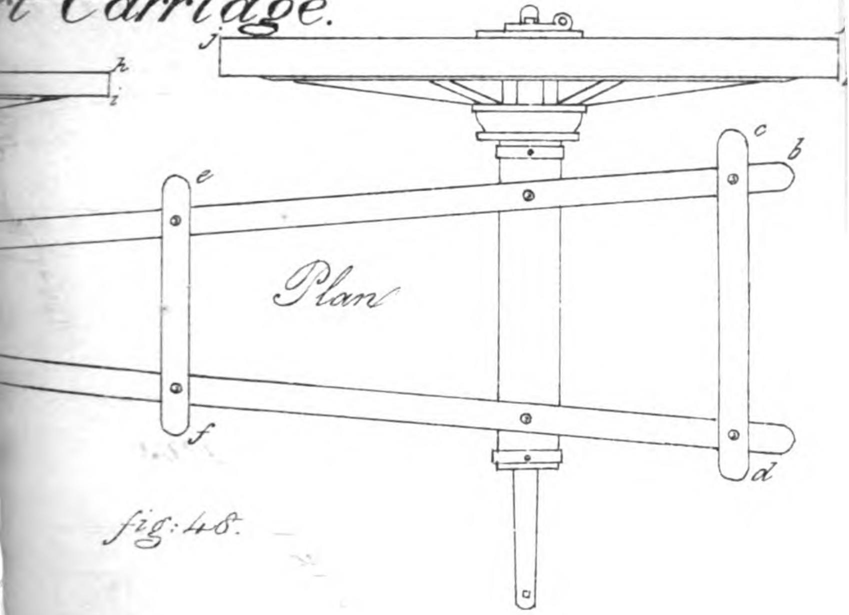
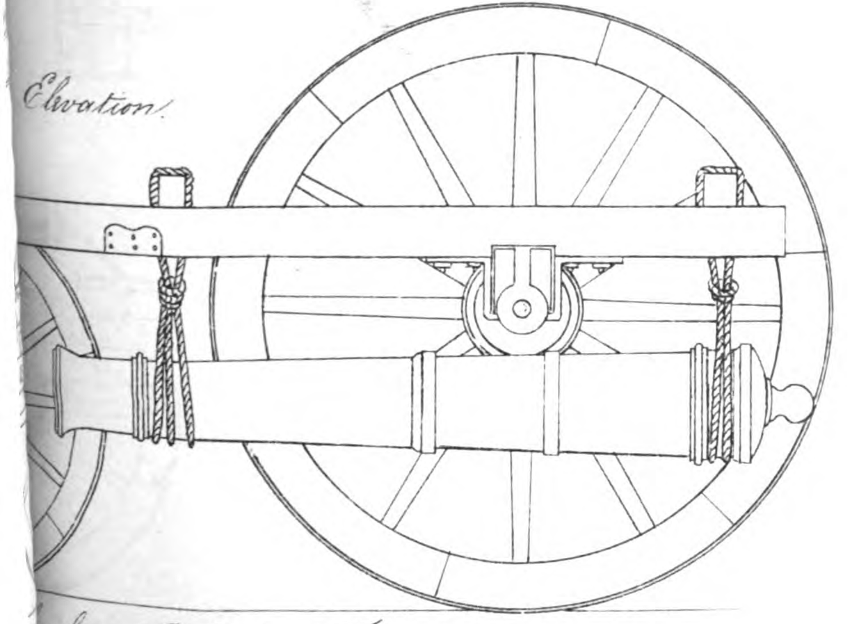


fig: 48.



of an Inch to a Foot.

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Quadruple

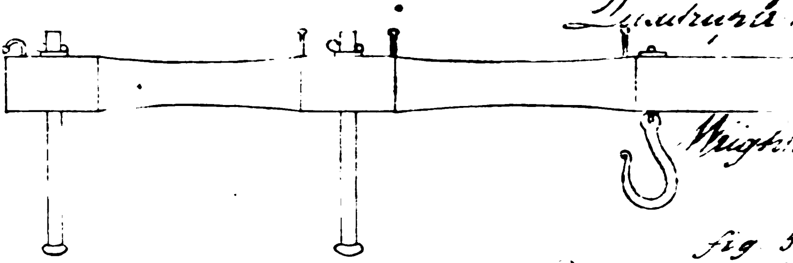


fig 5

Quadruple Tr

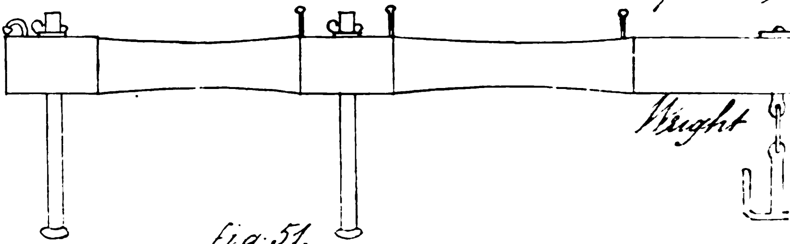


fig: 51.

Common Trace Yoke

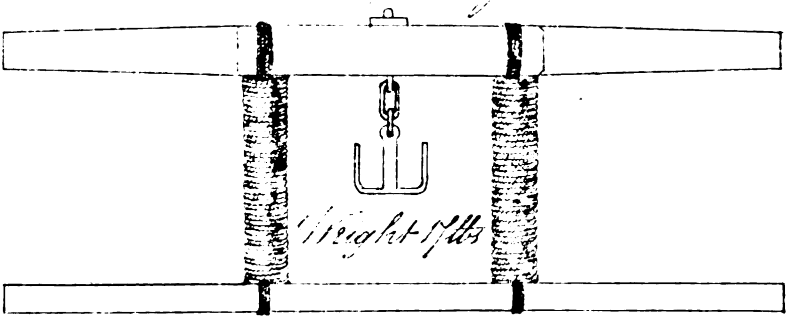
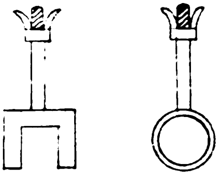
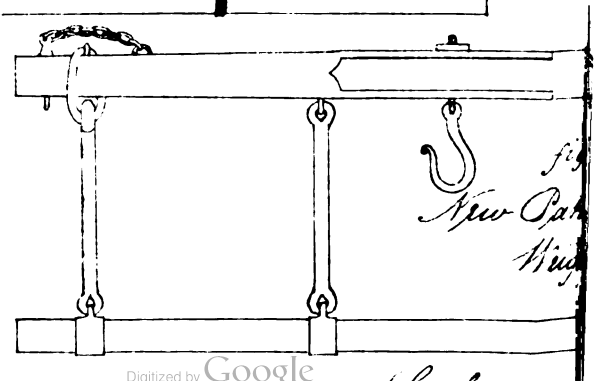


fig: 54

Swivel.





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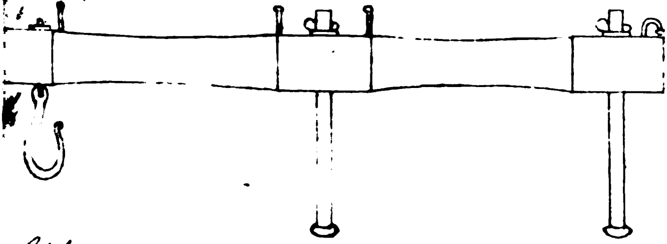
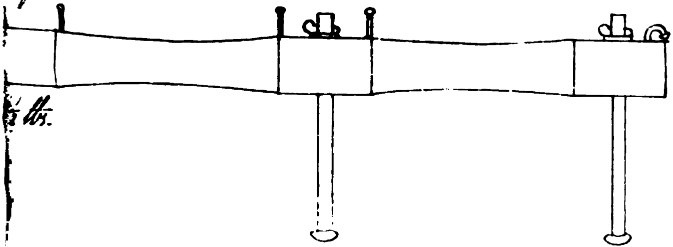


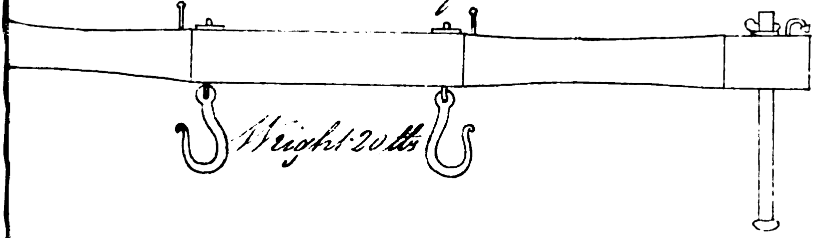
Yoke.

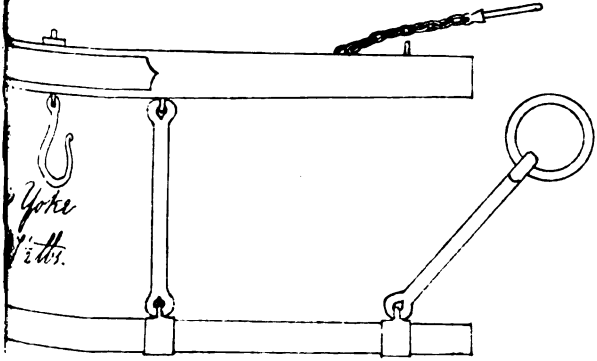


lbs.

fig: 52.

Common Pole Yoke.



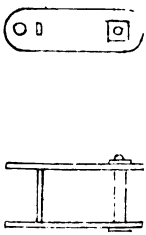


Yoke

lbs.

a Foot.

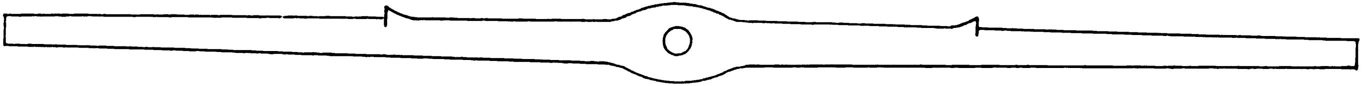
Clip [illegible]



Artillery

Fig. 56

Pole Bar.



Linking Chain

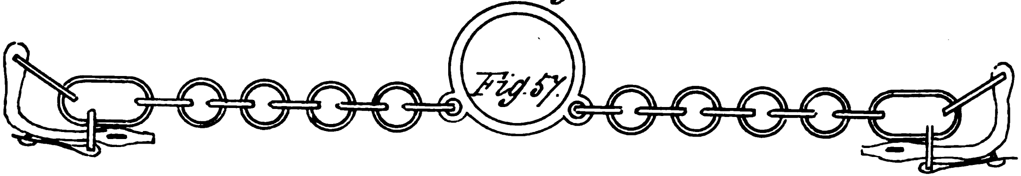
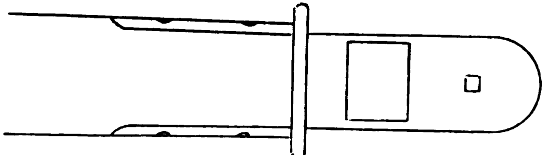


Fig. 57.

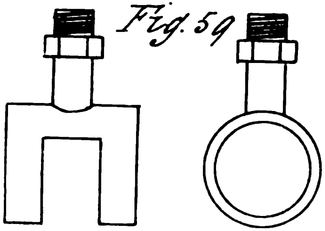
Fig. 58.

Pole End.



Swivel

Fig. 59



Pin.

TRANSPORT OF ORDNANCE AND STORES.

The Field Artillery of an Army should always be drawn by regular Cattle and Drivers. In India, Elephants, Camels, Horses, Mules and Bullocks, have been employed for the draft of Ordnance and Stores, and as the latter are the natural draft of the country, we must depend on it, in spite of all the outcry made against the horned cattle. On this side of India we have either had bad cattle, or when good, we drive them awkwardly. In the war with Tippoo Sultan in 1790, whilst some of Colonel Floyd's guns were abandoned to the enemy, the whole of Tippoo's Artillery joined in the pursuit of the British Detachment; again in the Mahratta war in 1804, when the drivers used to sit on the yokes, the Duke of Wellington writes in his published dispatches, vol. 2, page 360.

" It must be recollected, that in former wars, the utmost " exertion, which it was possible for the Army to make, was " to draw its Artillery to Seringapatam. It was not possible, and never was expected, that the guns and carriages " which were drawn there, should be brought away again; " and accordingly notwithstanding the undoubted talents and " great reputation of the Officers, who have at different " times led British armies to that place, it has invariably " happened, that by far the greater part of the train and " carriages have been left behind, when the army marched " away. Those who have seen the mode in which those " armies made their marches, and were acquainted with the " system under which cattle were, and must necessarily, be " procured for the service, will not hesitate to allow, that the " slowness of all our operations, and the necessity, to which " I have above alluded, of leaving our guns after they had " been drawn almost 300 miles, were to be attributed entirely to the faults of the system, under which the cattle " were procured for the service."

" But although I am addressing myself to an Officer, " whose experience reaches beyond the time to which I have " alluded, it is only necessary that I should advert, in proof " of my assertion, to the circumstances of the late War."

" From a variety of causes, it was necessary, at the commencement of the War, to hire cattle to draw the train, from " Madras to the frontiers of Mysore; and you will recollect " the difficulties under which you labored; and that in fact

" you could not have brought your carriages to the frontier, " without the assistance of the public cattle sent to join you, " and that if the circumstances of the times had required " that the whole army should have advanced to Poonah, you " would probably have thought it proper, to have taken with " you those carriages only, for which you might have a sufficient number of the public draught cattle."

" All the carriages attached to the Division under my " command, were drawn by the public cattle; and I shall advert to a few facts, to point out the difference between " this part of the equipment of the Troops in the late and " in former Wars."

" We marched to Poonah from Seringapatam, the distance " being nearly 600 miles, in the worst season of the year, " through a country, which had been destroyed by Holkar's " army, with heavy guns, at the rate upon an average of 13½ " miles a day; and if the 12 days on which we halted upon " the Toombuddra for orders be included, we arrived at " Poonah, in two months from the time we marched."

" On this march we lost no draught cattle. I remained in " the neighbourhood of Poonah, in a country, which deserves the name of a desert, for six weeks; and then " marched again with the train, in the same state as to " numbers, as when it left Seringapatam, and the troops and " cattle were in the Field during the monsoon."

" It is needless to advert to the distance marched during " the War, or to recapitulate the events, all of which must " shew the efficient state of the equipments; but it has been " frequently necessary for the Troops to march for many " days together, a distance from 15 to 20 miles daily; the " heavy artillery always accompanied them, and I always " found the cattle could go as far as the Troops."

" Upon one occasion I found it necessary to march a detachment 60 miles in 30 hours, and the ordnance and provision carriages, drawn by the Company's bullocks, accompanied this detachment."

" Instead of being obliged, as the Commanders-in-Chief of " armies in former wars have been, to leave guns and carriages behind, such was the state of efficiency of this department throughout this severe service, that I was able, " but with little assistance, to draw away the guns which " the Troops took."

" After all this service, in which so much country has been " marched over, the number of cattle which have died is, I " believe really not greater, than it would have been at the " grazing ground; and the department is, at this moment " in a state of great efficiency."

" It would not be difficult to prove, that in point of actual " expence, this establishment is cheaper to the public, than " to hire cattle in the old mode; but the consideration res- " pecting a public establishment of this description, is not " referable entirely to cheapness. It must be obvious to " every man, that in a war, such as the late war, there could " be no success, unless the Officer commanding the Troops, " was able to move, at all times, with the utmost celerity of " which Troops were capable, and to continue his movements " so long as was necessary."

" Rapid movements with guns and carriages cannot be " made without good cattle, well driven, and well taken care " of; and without adverting to what passed subsequently, " it is more than probable, that if I had had the service of " such cattle only, as served Lord Cornwallis or General " Harris in former wars, I should never have reached " Poonah, and that I should have been obliged to find my " way back without the wheel carriages, in the best manner " I could."

" I therefore take the liberty of recommending this establishment of cattle to your protection. It is founded upon " the most efficient and most economical principles, and will " never fail the Army, so long as it is superintended and " conducted, as it has been hitherto."

Horses are allowed to Horse Brigade Batteries; in good roads each horse may draw between 5 and 6 cwt.

Bullocks only, are allowed to Foot Artillery Batteries, in good roads each bullock may draw about 4 cwt.

TABLE *shewing the proportion of Bullocks required for the transport of Ordnance Carriages and Stores.*

NATURE OF CARRIAGE.	IN THE FIELD.						From station to station					
	Mounted.			Dis-mntd.			Mounted.			Dis-mntd.		
	In Yoke.	Spare.	Total.	In Yoke.	Spare.	Total.	In Yoke.	Spare.	Total.	In Yoke.	Spare.	Total.
Iron Gun Car. & Limber. 24 Pr.	44	9	53	20	4	24	26	5	31	12	2	14
„ „ „ ...18 „	38	8	46	18	4	22	24	4	28	10	2	12
„ „ „ ...12 „	30	6	36	14	3	17	18	3	21	8	2	10
„ Howitzer „ ...10 In	No Carriage fixed yet.											
„ Howitzer.. ..... 8 „	26	5	31	16	3	19	16	3	19	10	2	12
Brass Gun Car. & Limber 12 Pr.	12	2	14	6	1	7	0	0	0	0	0	0
„ „ „ . 9 „	10	2	12	6	1	7	0	0	0	0	0	0
„ „ „ ... 6 „	8	1	9	6	1	7	0	0	0	0	0	0
„ „ „ ... 3 „	6	1	7	4	1	5	0	0	0	0	0	0
„ Howitzer „ .. 8 In.	14	2	16	10	2	12	0	0	0	0	0	0
„ Howitzer „ heavy 5½ „	10	2	12	6	1	7	0	0	0	0	0	0
„ Howitzer „ med 5½ „	8	2	10	6	1	7	0	0	0	0	0	0
„ Howitzer „ ..12 Pr.	8	2	10	6	1	7	0	0	0	0	0	0
Ammunition Wag. H. A. laden.	8	2	10	0	0	0	0	0	0	0	0	0
„ „ „ „ empty.	6	1	7	0	0	0	0	0	0	0	0	0
„ cart foot „ laden.	4	1	5	0	0	0	0	0	0	0	0	0
„ „ „ „ empty.	2	1	3	0	0	0	0	0	0	0	0	0
Transport Carriage Spare..... (when with Iron Guns it will have the same number of cattle allotted to those several Calib: mounted.)	14	2	16	0	0	0	0	0	0	0	0	0
Mortar Cart spare............. when laden it will have additional Cattle in the following proportions.	6	1	7	0	0	0	0	0	0	0	0	0
Additional Cattle. Mortars Beds. Total												
10 In. brass. 6 6 12												
8 „ „ 2 4 6												
5½ „ „ 1 1 2												
Forge Cart loads 400lb. per Bullock	4	1	5	0	0	0	0	0	0	0	0	0
Artificers „ 400lb. „ „	4	1	5	0	0	0	0	0	0	0	0	0

In calculating the spare cattle the proportion is 1 to 5 in draft, and 1 to 6 in carriage of the *total* number of Bullocks required, and not for each carriage taken separately.

Gun and Mortar platforms, Gins, &c. &c. being carried on Platform or Country Carts, will be laden as far as practicable, in the following proportions, also in the removal of Stores from station to station.

For a Country Cart	800lb.	Bullocks	2.
For a new pattern Store.	800lb.	„	2.
For a Platform Cart.	700lb.	„	2.
For a Platform Cart.	1200lb.	„	4.

N. B.—The above Table is calculated at the rate of 240 lbs. weight, for iron Ordnance in the Field, and 400lbs. for occasional movement. For Brass Ordnance, the calculation is 400lbs. weight, whether for Field or occasional movement.

A pair of Bullocks will draw 1000lb. in addition to the Cart, which weighs about 472lb.

A good Bullock will carry with ease 120lbs.

One Bullock will carry the following number of each kind of Shot or Shell and Powder.

	24 Pounder.	18 Pounder.	12 Pounder.	9 Pounder.	6 Pounder.	10 Inches.	8 Inches.	5½ Inches.	4⅖ Inches.
Shot round loose...............	4	6	10	14	20	0	0	0	0
„ Spherical case empty......	10	14	20	24	40	0	4	0	0
„ „ „ filled........	6	8	12	16	24	0	2	0	0
Shells empty common..........	0	0	0	0	0	2	4	8	16

Gunpowder............2 Barrels. 45lbs. each.

MARCHING.

On orders being received for any portion of the Regiment to march, all Arms, Accoutrements, Ammunition, Ordnance and Stores, surplus to the Establishment or not required, are to be returned into the nearest Arsenal, receipts being taken.

Every Officer receiving Ordnance and Ordnance Stores, should inspect them carefully, and not only ascertain that they correspond with the list furnished by the person delivering them, but that the Stores are adapted to the Ordnance, for this purpose the Ordnance should be drawn out, the Ammunition unpacked and regularly laid out; should any difference appear, it must be immediately rectified or reported.

The Officer detailed, should without delay ascertain the most minute particulars regarding the Arms, Ordnance and Stores.

The Officer or Non-commissioned Officer in charge of Guns, should see that the Spunges are properly coated, particularly that there is a good thickness of wool or thrum at the end, in order to clean out the Cylinder.

In packing Ammunition in Waggons, Carts or Boxes, the greatest care is to be taken to prevent the oakum being tight wrapped round the Shot, but so loosely surrounding each, that when a man takes hold of the Shot with his right hand, he may slip off the oakum, gently drawing it through his left hand.

Limber boxes should be kept constantly complete with Ammunition, and the requisite small stores—all expenditure of Ammunition to be made from the Waggons or Carts as far as circumstances allow, or except in cases of emergency.

On the General beating, or other signal for march, the Artillery men strike and pack up their tents as quick as possible, and with the greatest care. As soon as the tents are packed ready for loading, the horses or bullocks put to the guns, &c. the Officers of divisions parade and inspect their men and prove every one to his station.

When guns travel, the bottom of the elevating screw should be carefully capped in wax cloth or flannel, to prevent the splash of dirty roads, rusting or clogging the thread of the screw. In marching, the elevating screw should invariably be let down not allowing above three or four threads to appear above the carriage, not only to secure it from being broken, but also to throw the weight forwards and thereby ease the draft.

The wheels and axletrees of all Gun Carriages being exactly alike, they should be occasionally changed, that is, the Limber wheels put on the gun axletree and vice versa, it has been ascertained, that the gun wheels, from the greater weight on them wear out much quicker than the Limber wheels.

Guns and carriages should be well washed if practicable, particularly the cylinder of the gun if it has been fired, and should on such occasions be laid under metal until perfectly dry.

Spunges wetted during exercise (which should be done by sprinkling them with water, and not dipping them entirely in the water bucket,) ought afterwards to be allowed to dry in the sun, but never washed, and the sinnet should be carefully combed out. Spunges should never be used at Drill without wads, nor should they be used to clean the gun after firing, but a spare spunge or two kept available for this purpose.

The Gun Lascars, Drivers and Horsekeepers, and in cases of Necessity, the Artillerymen are available for the purpose of cleaning the elevating screws, washing and cleaning the carriages after use, together with their appointments, and to keep them at all times clean and in good order.

All casualties on a march, or expenditure of ammunition, should be immediately reported, through respective Commanding Officers, on coming to the ground, and all deficiency or repairs immediately completed.

When Detachments are on service, reports of Casualties, engagements with an enemy, with a minute journal of the daily operations at seiges and any particular occurrence affecting such Detachments, or the professional character of the Regiment, should be made to the Assistant Adjutant General of Artillery, or Director of the Artillery Depôt either monthly, or as occasion may require.

Officers or Non-Commissioned Officers in charge, should be held repsonsible, that their Guns at all times on the march are ready for immediate service, (Waggons, Carts and Limber Boxes unlocked) and for the quantity and state of their ammunition, on which account, when Officers or Non-commissioned Officers in charge, are removed from one Brigade or Division to another, the relieving Officer becomes answerable, on all removals Officers receiving charge are to report to their Commanding Officers, that should the exigency of the case not allow an immediate examination, it may take place as soon after as possible.

On coming to the encamping ground the arms, carriages, waggons and carts should be most minutely examined, and any articles lost or broken instantly reported, the axletrees, bores and vents of the guns are also to be inspected, to see that they are clean, the gun ammunition and stores should be examined and reported to the Commanding Officer weekly, forwarding indents for the exchange of such articles, as are injured or wanting to complete.

Particular attention should be paid to the state of the ammunition, which should be frequently aired; and no fresh ammunition received without being gauged to the guns.

If a wheel be so disabled as not to be worth repairing, the nave if not damaged, should be at any rate saved. If the nave be good, a new wheel can easily be made from materials to be found on the spot, but it is very difficult to find a nave.

CROSSING RIVERS.

In India, Ordnance is generally conveyed across rivers when not fordable in boats, those which have been found most convenient, are the common country basket boats, covered with double skins of leather. They can be made with ease in all parts of the country, and can be transferred from one river to another. This method was suggested by that distinguished and experienced officer, the late Lieutenant Colonel Dalrymple, C. B., who was of opinion that no system for the passage of unfordable rivers in this country would be either effectual or economical, which was not founded on the simple contrivance of the natives.

In embarking Ordnance or carriages, the boat should be nearly filled with straw, brushwood, or any other light, soft substance, and the carriages should be embarked at a spot prepared by making a temporary wharf, at which the boat can float. The planks of the skeleton-platform will answer very well for making the wharf. The boat being brought as near to the bank of the river as possible, 2 sleepers are driven perpendicularly into the water, close to the boat, the distance between them, being that of the span of the wheels of the carriage to be embarked ; on them the side pieces of the platform are rested, forming an inclined plane towards the shore, their extremities are then secured by strong pickets, driven in to prevent them from sliding back, when of course the ends on the uprights would also slide off, and let the planks into the water. The wharf is now complete, and the carriage is gradually and carefully run up this inclined plane ; the trail supported by a cross-piece of wood fastened under resting on the side planks ; on the wheels reaching the upper part of the wharf (the ends of which, it is scarcely necessary to remark, should not project far beyond the upright, or the carriage would be elevated too much above the boat and probably in its descent, destroy it,) the trail is raised and the piece gently run off into the boat, the the substance with which it is filled, preventing any shock, or the carriage from running through the sides.

Should the inclined plane thus made be very steep, fasten a rope to the lowest part *behind* each wheel, carry the end to the front resting on the tire, cut a notch in the front part of each side piece to receive the ropes, the ends are carried under the planks to the rear, at these the men haul, when the gun will be easily run up, with the assistance of hand spikes : care must be taken on the wheels quitting the planks, that the weight in front does not preponderate so as to turn over, this is prevented by those at the trail who must keep a sharp look out.

Dismounted guns are embarked nearly in the same manner ; the piece is laid lengthways across the lower part of the wharf, ropes fastened round it, the ends carried to the front over the notches, and brought back in the manner above described to the rear, by their means and hand spikes, the piece is drawn up the slope, and gently let into the boats.

Should the river have steep banks, this inclined plane will be unnecessary, the bank may be cut away so as to admit of the planks resting on it, and the uprights being horizontal or inclined towards the boat. The Officer must use his judgement, according to existing circumstances.

Basket boats have been much improved by Lieut. Davis of the Madras Engineers, by means of a second bottom exactly similar to the other, which is joined to it, but inverted ; the sides of the boat are produced so as to join the edge of this second bottom all round, still retaining the inner sides, which adds much to the security of the boat, by not allowing any thing in it to penetrate through the inner side near the curved part at the bottom, which is frequently the case, the outer side will still preserve it. But this is not the principal advantage, this curved part downwards by retaining the water, will prevent the possibility of its upsetting, and add much to its buoyancy, and enable it to bear a much greater weight, without risk or sinking. One of 12 feet diameter will convey a 24 pounder. A very good idea will be formed of the two bottoms, by placing two similar saucers on each other their convexities outwards.

Basket boats are the simplest and most expeditious mode of crossing rivers, and at the same time the most dangerous when the necessary precautions are not taken; with common care, however, they are perfectly safe. When horses are available, they will greatly facilitate the crossing of the boat, there is no necessity of using paddles and the passage may be accomplished in one third of the time. Two horses may be taken over alongside each boat.

When a few horses have crossed they should be kept near the landing place to encourage the others coming over. Should any accident or difficulty occur with the horses, they should be let loose, as however broad and rapid the river may be there is seldom any danger of their not reaching the shore.

On many rivers there are people who swim horses over, they being supported by gourds or pumpkins, when these people are to be procured, their method should be preferred as being the most expeditious and safe. Tie a rope about 2 feet long, one end to the horse's under jaw, the other the man holds, on no account should a horse have a bridle, or any other ropes about him, with gourds 40 or 50 horses may be taken over at a time as they encourage each other.

To cross over a bad nullah, where the horses have not footing sufficient to take over gun and limber together; unlimber, and take the limber over first, then fasten drag ropes from the limber to the trail of the gun carriage, and by that means drag the gun over.

EMBARKATION.

In embarking ordnance stores, the first thing necessary is to prepare a list of all the articles to be embarked, with the weight and tonnage of each. This list must have a large column for remarks. The tonage required for bulky articles will be generally one third more than their actual weight;

but the tonnage of ordnance, shot, shells, &c. will be equal to their weight.

If vessels be paid for according to the tonnage they carry, the masters will, of course, stow away as much as the ships will hold; but, if by the voyage, they will be averse to loading their ships too much; a naval Officer should therefore always attend to see that the ships are properly stowed.

Ordnance and stores may be embarked, either for the purpose of merely transporting them to another situation or for a military expedition. In the first case, each ship must be stowed with as much as it will carry, and every article that relates to one particular species of service or ordnance, must be put on board the same ship, that in case one ship be lost the others may remain in themselves complete. This principle must of course likewise be attended to, in an embarkation for an expedition but a more particular distribution of the stores must take place when on board. With each piece of ordnance must be placed every thing necessary for its service; its side arms, carriage, limber, ammunition waggon, ammunition, &c. so as to be readily come at when required to be disembarked.

If it be an embarkation of ordnance, &c. for a seige not only every thing necessary for the service of the ordnance should be embarked with them, but also every thing necessary for the construction of the battery on which they are to be mounted. It will be adviseable in this case, to put different natures of ordnance in the same ship in proportions according to the service required of them. In general it will be best to put the heavy articles in first, and every thing that is light, easy to be removed, or likely to be first wanted, on the top.

Previously to embarkation, the guns, carriages, waggons, &c. must be dismounted, but first numbered as follows, and the number of each article marked in the list of the column of remarks. Give each piece of ordnance and its carriage the same number: give the ammunition waggons and the other carriages different numbers from the ordnance carriages: then give every limber, whether of ordnance carriage, or ammunition or other waggon, the number of its respective carriage. If for a simple transport, arrange the small stores, side arms, &c. according to their several natures; but if for an expedition every thing belonging to each particular piece of ordnance must be collected together, and the cases, or chests, in which they are put, marked with the number of the piece of Ordnance to which they belong, their natures and description.

If there be any doubt of the different parts of the carriages, being made with that uniformity so essentially necessary, every part that is separated must bear the number of its carriage. This precaution at any rate may be a good one, if the same vessel contains different natures of ordnance or carriages.

The axle-trees need not be taken off the carriages if the vessel be of sufficient size to admit them when fixed, as they are not easily replaced without workmen and a tedious operation.

When a carriage is dismounted all the small articles, such as elevating screws, linch pins, drag washers, cap squares, &c. must be carefully collected and secured in a box, marked with the description of stores and number of the carriage to which they belong.

All carriages or waggons embarked with their axle-trees fixed, must be arranged in the ship, side by side, and alternately front and rear, that their axle-trees may not interfere with each other, and take up too much room.

Every transport or other vessel employed in the conveyance of troops or stores for an expedition, should be numbered on the quarters, and on the bows, with figures as large as two or three feet, and likewise on the sails, that they may be known at a distance.

The number of the ship her name and tonnage, and the masters name must be entered in the list of stores which she carries.

In disembarking ordnance and stores, they must be landed in order exactly the reverse of that in which they were shipped. The carriages and waggons must be mounted as soon as possible, and each piece of ordnance with its waggon &c. must be arranged as far from the shore as possible to prevent confusion.

If the disembarkatian be to take place in the presence of an enemy, the vessels of course must be loaded accordingly, and the field ordnance, with their carriages, ammunition, &c. must be so arranged so as to be first landed, and with the greatest possible ease. In this case, the intrenching tools, must also be kept in the greatest readiness.

PACKING.

Guns, Shot, all the metals, and all heavy articles, are calculated by weight ; carriages of all sorts, and all bulky articles by measurement, 40 cubic feet should be rated at one ton, but sometimes, owing to the dearth of employment for vessels, the ship owners, and agents are glad to bargain for freight at the rate of 50 feet per ton. The tonnage statement is furnished to the Marine Board, and vessels are engaged by the latter authority ; when supplies are sent to any port in the Madras territories, freight is bargained for at so much per ton, except in the instance of gunpowder, which is generally paid for by the barrel ;—when stores are sent to foreign settlements, or when war expeditions are dispatched ; vessels are engaged either for a certain sum per month ; or for the trip ; that is, they are taken up as "Transports." All vessels engaged for the transport of stores are, or should be, surveyed by competent officers.

When the officer is made acquainted with the name of the vessel engaged for any particular service, he applies to the Master Attendant for as many boats and rafts as may be judged necessary. Heavy guns, say guns above 20 cwt. are shipped by means of rafts, all light ordnances packages of stores, &c. are embarked in boats.

Gunpowder.—Gunpowder is always dispatched in barrels, either whole (90lbs) or half (45lbs) barrels, each barrel is securely packed ; first, it is wrapped with wax cloth, over which is a wrapper of gunny ; the description of powder and its destination is marked with paint on each barrel.

Musket Ammunition.—Musket Ammunition is sent mostly in barrels and occasionally in boxes, which are covered with wax cloth and gunny, like the powder barrels ; the packing barrels are of various sizes, but all musket ammunition intended for actual service in the field, is packed in portable barrels or boxes containing each 500 shotted musket cartridges, one of these may be carried with ease by a cooly, (60lbs) two of them make a bullock load ; the same barrel or box will contain 800 pistol cartridges.

Carriages and Carts.—Carriages and Carts are taken to pieces before they are put into the boats, that is, the wheels are taken off,—hitherto it was usual to number and mark the wheels with paint right, left, &c. &c., this is not now considered necessary because the naves of wheels, and the arms of axles of all light field carriages are intended to correspond, perhaps, however the old system should not be abandoned too hastily, at all events it should be adhered to in the instances of heavy field carriages and carts.

Musketry and Swords.—Muskets are packed in Arm-chests, 20 muskets with bayonets and scabbard in one chest—the muskets are arranged in rows or tiers, each tier is secured by battens, this mode of package is very safe and perfect—pistols, 20 pairs in one box—swords cavalry with iron scabbards, 50 in a case—both the pistols and the swords are battened like the muskets.

Accoutrements.—When Corps proceed on ship board, their arms and accoutrements are packed in the Arsenal, the arms as above and the accoutrements in cases, 70 complete sets in one case, this has reference to the accoutrements of Corps only, when new accoutrements are sent from the arsenal bayonets, belts, pouch belts, &c. &c. are all packed separately.

Shot and Shells.—Round shot and shells require no package.

Cannister shot should always be packed in strong boxes. In preparing the general return of stores for embarkation much as regards package should be regulated by circumstances—Stores sent from the Presidency for the station of Masulipatam, an economical system should be observed. cases of any kind and of any size should be used; stores for Hyderabad and Nagpore are sent viâ Masulipatam, then the stores should be packed so as to be convenient both for sea and land transport; there is a packing case much used in the Arsenal, the pattern of which was suggested by Lieut. Brookes, and which measures about 25 cubic feet, this case filled with the stores most generally in use, would be convenient on ship board, and would be the average load for a country cart travelling by land.

If a vessel is loaded with stores all to be landed at one port, then the heaviest articles, ordnance, &c. are to be first embarked, then the bulky packages, and last of all, the gunpowder and shotted cartridges.

If a vessel taking consignments for two ports, then the stores for the most distant port are to be the first embarked, in the same order as above, except that all the gunpowder and shotted cartridges should remain on shore until the day of sailing, or until the day before sailing.

In war expeditions, all the packages should as far as practicable be portable—at least, a large proportion of the stores that would be required immediately on landing, should be packed in cases or bundles not weighing more than (60lbs.)

STOWAGE OF MILITARY STORES FOR CONVEYANCE IN THE FIELD.

ARTICLES.	REMARKS.
Platforms Gun and Mortar..	On Platform Carts.
Gins........	Do. do. do.
Shot and Shell.......	In Gunnies for Bullocks—Vide Lt. Brookes Table No. 16 for number.
Carcasses Empty...........	Do. do. do. do. do. do.
Do. Filled..........	Well secured in small Boxes covered with Gunny and Dammered—Carried on Carts.
Canister Shot	In Boxes, not exceeding 60 lbs. each to be securely packed, the box to be covered with Gunny but not Dammered—Carried on Bullocks.
Spherical Case filled with leaden Balls.	As above,—Should there be a deficiency of Boxes they can be carried in Gunnies, care being taken that they are well plugged
Cartridges Cloth Empty. ...	To be packed in Bales covered with Wax Cloth and Gunny not exceeding 60 lbs. each, for Bullock Carriage—In the wet season empty Powder Barrels covered as above will be a good stowage.
Gunpowder...............	On Carriage Bullocks.
Fuzes.	A small supply of each description of Fuzes properly packed, a few Bundles of Portfires, and a small Box of Quick Match to be packed in each of the Laboratory Chests, the remainder to be packed in Boxes covered with Wax Cloth and Gunny and conveyed on Carts.
Portfires................	
Quickmatch.............	
Match Cotton......	Packed in Store Gunnies—Bullock Carriage.
Bags Sand Dungaree......	Do. Bales do. do.
Axes of Sorts..........	Packed in Bundles 60 lbs. each—Bullock Carriage
Mamoties................	
Hooks Bill.....	
Hooks Sap...	On Platform Carts.
Crows Iron..............	
Shovels and Spades.	
Adzes Brass Coopers.	Packed in Laboratory Chests.
Drivers.................	
Vices.	
Augers Fuze and Aprons Lead.................	
Axletrees Iron and Wood...	On Platform Carts.
Blocks Wooden Shell......	In Laboratory Chests.
Barrels Budge............	On Platform Cart.
Bits Gun Steel, Bottles Copper, Boxes copper dredging	Packed in Laboratory Chests.

Articles.	Remarks.
Boxes, Tin Tube, Wooden Fuze	Packed in Laboratory Chest.
Bellows Hand for proving Shells, and Candles Wax	
Buckets Wooden, Tar, Water, and Buckets Leather	On Platform Carts.
Cloth Waxed and Vizagapatam	Packed in Bales 60 lbs. each, covered with Gunny, Bullock Carriage.
Chains Measuring, Chalk, Compasses &c.	Laboratory Chests.
Cylinders	
Choakers Iron	In a small Box on Platform Cart.
Coins	In the Limber Box of Heavy Field.
Drivers and Setters for Fuzes, Engines Fuze, and Esses Iron	Laboratory Chests.
Fellies of Sorts	In Bundles—Bullock Carriage.
Files, Funnels, Formers for Cartridges	Laboratory Chests.
Guages, Glasses Perspective, and Hammers	
Handspikes Traversing	One with each Gun the remainder on carts.
Do. Purchasing	Two with each Gun Ammunition Cart and Waggon, a few loose with the line of Carts, the remainder in Bundles—On Carts.
Handspikes Gin Spare	On the Carts with the Gins.
Haversacks Leather	One in Limber Box Heavy Field—Four in each Laboratory Chest, the remainder in cases on Carts.
Yokes Quadruple	On carts.
Do. Common	
Heads Rammer and Spunge, Horns Priming, Hooks Cant, Irons Priming, Instruments Perpendicular and Quadrants	In Laboratory Chests.
Jacks Hand	On the Carts with the Gin.
Keys spare of sorts, Knives Laboratory	In Laboratory Chests.
Knives Grass	In a Bundle on Cart.
Ladles with Worms	On Carts.
Leathers or Tapes Bearing	50 in each Laboratory Chest the remainder on Cart packed in a small Box.
Lights Blue and False	Packed in a Box on Cart.
Lanthorns Dark and Horn	One of each, in each Laboratory Chest, the remainder, packed in Box, on Cart.
Line, Hambro, Mer, Log, and Tracing	In Laboratory Chests.
Lintstocks with Cocks	On Cart.

Articles.	Remarks.
Locks pad with Keys, Lynchpins and Marline-spikes	In Laboratory Chests.
Mallets for driving Pickets	With Park Pickets, on Bullocks.
Needles of Sorts	In Laboratory Chests.
Nets Coir filled with wads	On Carts.
Naves Wooden	Do. do.
Oakum Europe	A small quantity of fine clean Oakum in each Laboratory Chest for wrapping Fuzes, and a supply packed in Store Gunnies carried on Bullocks.
Junk Europe	On Bullocks.
Pickets Park	Do. do.
Do. Platform	On Cart with the Platforms.
Plummets for Mortars.	In Laboratory Chests.
Poles Limber Spare	On Carts.
Pincers Iron and Brass	In Laboratory Chests.
Pouches Priming	Four in each Laboratory Chest, the remainder in a Box, on Cart.
Punches Tube, Rasps Fuze, Relievers for Spring Spikes	In the Laboratory Chests.
Rope Europe and Ratline	On Carts.
Ropes Drag Heavy Field	One set with each carriage, exclusive of a supply in Store to be packed in Bundles for Bullock Carriage.
Do. do. Platform Cart	One set to each Cart,
Rings spare for Yokes, &c.	In the Laboratory Chests.
Rammers Earth	On Carts.
Rockets Signal	In a Box covered with Gunny and Waxcloth, on Cart.
Scales Copper 7 and 4 lb. Setts	One of each, in each Laboratory Chest, the remainder carefully packed in a Box, on Cart.
Scissors, Screw Nuts, Saws Fuze, Setters Saw, and Scales Gunter Brass.	In the Laboratory Chests.
Scrapers Gun	The scrapers to be kept in the Laboratory Chests, the Staves on Cart.
Searchers Gun	On Cart.
Sheepskins for Mortars	In Store Gunny.
Sinnet, Spunyarn	Packed in Bundles carried on Carts.
Spunges Gun	On Carts.
Do. Mortar	On Mortar Carts.
Spikes Gun	In Laboratory Chests.
Spokes Heavy Field and Platform Cart	Well lashed in Bundles, carried on Bullocks.
Spirits of Wine	One Bottle in each Laboratory Chest, the remainder securely packed in a Box,—on Cart.

ARTICLES.	REMARKS.
Stocks Portfire............	In Laboratory Chests.
Staves Sponge............	On Carts.
Silk for Plummets........	In Laboratory Chests.
Thread Cotton............	1 lb. in each Laboratory Chest, the remainder in Store Gunny--Bullock Carriage.
Tar and Grease filled kegs..	On Carts, used as required, and the Kegs refilled when an opportunity occurs.
Tar............. ..Barrels	On Carts.
Tarpaulins................	Those required for the Covering of the Magazine and Stores are carried on Bullocks, a supply to be kept in reserve conveyed on Carts.
Twine Gunny............	Store Gunny.
„ Europe and Country	1 lb. of each in each Laboratory Chest, the remainder packed in a Box--on Cart.
Vices Bench, spare Washers and Wrenches............	In the Laboratory Chests.
Wads......................	Vide Nets Coir.

Memorandum.

If two or more laboratory chests, the stores for them, should be equally divided, each description to be packed in Bundles, and correctly marked. The heavy articles to be stowed first, and then the light: The ammunition carts or waggons are considered to be completed with their established equipment exclusive of the articles enumerated in this list.

The boxes containing the Fuzes, Portfires, Quick-match, Haversacks, Priming Pouches, Bearing Leathers, Blue and False Lights, Rockets, Lanthorns, Scales and Weights small, and Spirits of Wine, should be packed on one or two Carts and not dispersed with the other Stores. The Sinnet and Spunyarn should be on one cart.

Every Box, Package, Shot, Powder, Ammunition, and Store Gunnies should be correctly marked. The Gunpowder S. G. and L. G. should be piled separate. The Ammunition Musket and Pistol in like manner. The Shot and

Shells piled in their Gunnies according to Calibre. The Store Gunnies and Gunnies with leaden Balls separate, if thus arranged, the account after a march is soon taken.

The Artificers should be told off to the line of Carriages and Carts, they should carry a Light set of Tools with them, and be supplied with a few of the following Articles, Iron Bands for Spokes and Fellies, Esses Iron, Lynchpins, Washers, Nails Tire, Nave and Packing, Keys and Rings for Yokes.

The Magazine should move in the following order.

1st Gunpowder.
2d Ammunition.
3rd Shot and Shells.
4th Sundry Stores.

The Lascars who march at the head of the Magazine should be furnished with Two Bill-hooks, and Two Axes Hand, well sharpened, they will be found of great use in an intersected Country, for opening a passage in the Hedges, for passing the Bullocks through.

At Night a Warrant Officer should go round the Bullocks at the Magazine (taking a Maistry with him) and see if the Bullock people have any Fires between the Bullocks, this they are very apt to do, if any Fires are discovered, the offender should be handed over to the Maistry and punished. On approaching the Ground of Encampment,a Warrant or Non-Commissioned Officer belonging to the Magazine should advance a small distance in front of the Bullocks, and examine the Ground where the Tarpaulins are put for the reception of the Gunpowder, and should he discover any places where fires have been made he should examine them with his *hand*, the only method to find out whether any fire yet remains, should fire be discovered in any place he should send word to halt the Magazine until he has properly extinguished it.

The Tarpaulins to be taken from the Piles of Powder and Ammunition in the presence of a Warrant Officer, who should have all the Maistries in attendance to prevent the Bullock people taking away their loads in an irregular manner, likewise on coming to the new ground, the

Maistries must attend at the Park, until all the Stores are counted, if any loads be deficient, Maistries should be sent in search of them.

Every Carriage Bullock should be supplied with a Head-rope. This is a rope which is fastened to the Horns, if no Horns, to the Neck, the other end is tied to the Load, should the Bullock throw his Load he must remain with it, which will soon be discovered and few losses will occur if this rule is observed.

Spherical case Shot, or Common Shot, when fixed to Bottoms must invariably be packed in Boxes not exceeding 60 lbs. each, for Bullock Carriage.

Distribution of Warrant and Non-Commissioned Officers on the Line of March.

1 Warrant Officer in Charge of the Gunpowder and Ammunition.

1 Do. do. in Charge of the Shot and Shells.

2 Non-Commissioned Officers, in Charge of the remaining Stores Carried on Bullocks.

2 Warrant and 2 Non-Commissioned Officers with the Line of Carriages.

The Warrant and Non-Commissioned Officers with the Magazine should keep on the flanks of their respective charge, keep the Bullocks well closed up and not allow any Baggage to mix with their Bullocks, or to cross the Line, they must be alert at all times, and see that the Guard do their duty.

The Warrant and Non-Commissioned Officers with the Line of Carriages, should disperse themselves along the Line, keep the Carriages well closed up, not allow of any Baggage to cross the Line, and should any Carriage Break down they should send a report to the Commissary and get the Carriage repaired as expeditiously as Possible.

A Warrant or Non-Commissioned Officer should remain in the rear and see all up to the New Ground.

Duties of Warrant and Non-Commissioned Officers on coming to the New Ground of Encampment.

Each Warrant or Non-Commissioned Officer must examine the respective Stores in their charge, and see the loads counted, and if any Gunnies require repair or exchange, to have it instantly done, when repaired, to be carefully put into Piles. The Gunpowder and Ammunition, to be properly secured, with *good Tarpaulins,* lashed round and picketed, all deficiencies, exchanges, and repairs to be reported to the Commissary.

The Warrant and Non-commissioned officers with the line of Carriages, are carefully to examine them so soon as drawn into line, report all breakage, and have them sent to the Artificers for repair, they are also to see them returned to the park, and put in their proper places, report the proper days for greasing of wheels, and see that it is done. If any Gun Ammunition, is on Carts, or Waggons, belonging to the park, it should be daily examined, and unstowed every fourth day, if circumstances will permit.

REGULATIONS TO BE OBSERVED IN DRYING, SIFTING, AND PROVING GUN POWDER, &c.

The terrace or platform on which the powder is to be dried, to be well cleaned, free from damp, and moisture, and covered with Tarpaulins, and powder-cloths over them.

Sentries with side arms to be placed at intervals round the terrace 20 or 30 yards from it, according to circumstances, and no person but those concerned in the operation to be allowed to pass within them.

An ordnance Officer invariably to be present from the time the powder is taken out of the Magazine till returned. The Superintending Officer to visit the platform frequently while the powder is on it.

The powder being prepared is to be poured out of the barrels, and winnowed through sieves to clear it of dust and dirt, then spread uniformly with wooden rakes on the cloths not more than 2 inches thick, in any part, all lumps to be broken by the hand, that all alike may have the benefit of the sun, to insure which, the whole every half hour to be raked with wooden rakes.

Each lot should remain out 4 hours, when the sun is very powerful, or 6 when not particularly so, and those days should be selected that are clear and dry, free from clouds and moisture.

In re-barrelling the powder, 45lbs. only to be put into a 50lb. barrel, and 90lbs. into 100lb. barrel, it having been found by experience that powder keeps better, by the empty space being left in each barrel, and moreover, the powder by having more room, receives greater benefit from turning the barrels than if they were quite full.

The drying of powder at all Stations to take place under the superintendence of the senior Officer of Artillery.

On all occasions of removing gun-powder from one barrel to another, or where a new head is put in, or the original proof mark in any way injured, it should be carefully repainted; and in proceeding to reprove powder, each description (large, and small grain) may be kept and proved separately, and the gun powder of each kind, of one year's manufacture only, to be mixed together.

Proving Gunpowder.

It is incumbent on every Officer in Command of Artillery, to ascertain by proof the quality of his powder, whereby the charge should be regulated according to distance, for although $\frac{1}{3}$d weight of shot for battery guns is the established full charge, both in Her Majesty's service, and under this Presidency, yet, in various situations and depending on local circumstances the charge should be reduced to $\frac{1}{4}$ and even $\frac{1}{6}$th of the shot's weight, as also in some cases an increased charge may be found necessary.

All gun powder manufactured at Madras, is proved at Artillery Head Quarters by the Director of the Artillery Depôt, under the orders of the Commandant of Artillery.

On the 1st of each month, an Artillery Officer is sent to the mills for the purpose of selecting one or two barrels out of those manufactured the preceding month.

These barrels are then sent to the Mount for proof.

The ordnance used is an iron eight-inch mortar.

Two charges are used, viz: 1lb. and 2 ounces.

The projectile is a solid steel ball, weighing 65lbs. and 7·87 inches in diameter.

With every different sample of gun powder, three rounds are fired, and the extreme range of the three rounds, being summed up, and divided by three, gives the medium range, which is considered the mean strength of the powder under examination.

The standard range is, with 1lb. 500 yards, and with 2 ounces 40 yards.

The accompanying form of proof report will shew the various observations, &c. that are recorded and is the form observed by all Artillery Officers at out-stations, who have occasion to prove their powder either for practice or service.

Fine powder is sometimes proved in the following manner.—A Fuzil barrel is fitted up in a strong framing, Fig. 66 loaded with four drams of powder and a steel ball weighing 276½ grains, and ·64 inches diameter, and fired against wet half inch Mangoe boards, or boards of any tough wood, sliding into grooves in a box, three quarters of an inch apart from one another, and the first thirty feet distant from the muzzle of the barrel Fig. 67. The usual penetration is from ten to twelve boards.

FORM.

Proof of Gunpowder made by order of   *at*   *on the*   18 .

		POWDER.								MORTAR.																				SHELL.							RANGE.		DISTANCE.			
																BORE.						CHAMBER.																				
																Diameter.										Diam. of Entrance.																
Nature of Ordnance.	No. of Firings.	Weight.			Nature and when made.	Original Proof.	Weight of Bed.			Weight.			Length.			Vertically.		Horizontally.		Length.		Shape.	Contents.	Length.		Vertically.		Horizontally.		Weight.	Diameter.		Number of	Elevation.	Flight.		Right.	Left.	Real.	Medium.	Established distance.	REMARKS.
		lb.	oz.	dr.		yds.	cwt.	qr.	lb.	cwt.	qr.	lb.	ft.	in.	ths.	in.	ths.	in.	ths.	in.	ths		lbs.	in.	ths.	in.	ths.	in.	ths.	lbs.	in.	ths.		deg.	sec.	pts.	yds.	yds.	yds.	yds.	yds.	
																																										Proof commenced at —— and ended at ——. Atmosphere dry, sky clear,

A. B *Captain,*
Superintending Proof,

Gunpowder Barrels.

Gunpowder barrels consist of staves, a circular top and bottom, kept together by four copper hoops. The whole barrels are made to contain 100lbs. and the half barrels 50lbs. of powder each ; but 90lbs. only are put into the whole barrels and 45lbs. into the half barrels. This arrangement leaves room for the shifting of the powder and preserves it better.

Weight of an empty whole barrel......33lbs...Fig. 68.
„ „ half „ ......21lbs...Fig. 69.

Barrels containing different powders, are distinguished by the color of the marks on them. The initials of the superintendent's name, date of manufacture, nature of powder, and medium range are all marked on Gunpowder barrels.

Red paint denotes............Large grain.
Blue do do ....Small do.

In permanent magazines powder barrels are generally packed in tiers of 3 barrels each ; this arrangement is made to guard against accidents, but in the field, where magazines are only formed for a short period, powder barrels may be piled like shot, and in almost any number, owing to the very great power the barrels have in bearing weight.

Dimensions af Barrels.

	90lbs.		45lbs.	
	Feet.	Inches.	Feet.	Inches.
Depth........................	1	9.61	1	5.13
Diameter at the top...........	1	3.61	1	0.37
„ „ bulge.........	1	5.36	1	2.0
„ „ bottom.........	1	3.51	1	0.31
Hoops Breadth..............	0	1.30	0	1.30
Bulge Thickness.............	0	.10	0	0.10
Weight with Rivets ....lbs.	$2\frac{5}{16}$	.	$2\frac{1}{16}$	.
Hoops Breadth.............	0	1.30	0	1.30
Chime Thickness.............	0	0.10	0	0.10
Weight with Rivets........lbs.	$2\frac{3}{16}$	.	$1\frac{15}{16}$	.

N. B.—Every barrel to have 2 copper hoops of each kind and of the above dimensions.

Budge Barrels.

Fig. 70.

Budge barrels are used in batteries to keep the powder, from accident. They hold from 40 to 60lbs. of powder. At one end there is a leather top which is closed in by strings.

Tools necessary for opening and closing barrels.

Cooper's vice.
,, Adze,
,, Driver.
Funnel.

Preservation of Gunpowder.

To preserve gunpowder from the effects of the atmosphere, it should be kept in as dry a place as possible. In garrisons, powder magazines are isolated buildings of a construction so solid as to resist the fall, and bursting of shells, and they should be placed in situations as far removed as possible from the front likely to be attacked, and surrounded by every precaution to render them as little liable to injury as possible.

The dimensions of one of Vauban's principal magazines Fig. 71 are as follows. The apartment is sixty feet long, by twenty-five feet wide ; the interior height of the wall above the floor is six feet where the spring of the arch begins ; the long walls or piers are eight feet thick, strengthened exteriorly by four counterforts, the masonry is three feet thick at the thinnest part of the arch, and about 8 feet at the angle over the key of the arch. The end walls are 4 feet thick, in one is a door and a window, and a window in the other, no iron is admitted into the construction, the doors and windows being lined with sheet copper ; the floor is supported on lines of small brick pillars, so as to keep it dry and give a free circulation of air under it. The magazine is ventilated by air holes cut in the side walls so as to leave a solid die of masonry in its centre, and being further protected by perforated sheets of copper, nothing can be insinuated through these openings. Powder being a most delicate agent and susceptible of imbibing atmospheric moisture, every means must be used to obtain good ventilation and equal temperature for it.

The powder is usually piled in tiers of 3 barrels, Vauban's magazine just described will thus hold one thousand and fifty barrels, or one hundred thousand pounds of powder. As a further security the whole building is surrounded at a distance of 12 feet from its walls, by a wall of 10 or 11 feet in height.

In the field when in batteries, splinter proof timbers for magazines are cut, 12 feet in length and from 8 to 10 inches in breadth and thickness, and placed against an epaulment parallel to the place at an angle, making the base equal to half the height. They are then covered with a tarpaulin extending well over the top of the epaulment, over which are laid one or two rows of filled sandbags so as to prevent the possibllity of the tarpaulin being cut by the splinters of shells. A second tarpaulin is usually thrown over the exterior in rainy weather. On this construction the magazines are perfectly dry and sufficiently spacious.

The best situations for magazines are on the flanks of the batteries. Nothing can be worse than to place them in the rear of the centre of the battery, as then every cartridge has to be carried along the most exposed and dangerous part of the battery, and the number of accidents and casualties which arise therefrom is very great indeed. It is best to have two magazines formed, rather than one exceeding ten or twelve feet in length; when two are made they are placed one on either flank. A situation which is found to answer extremely well for the magazines of batteries constructed in advance of a parallel, is at the extremity of a cut, made perpendicularly through the parapet of the communication from the parallel, at ten or twelve yards before arriving at the battery.

The level of the floor of the magazine is then kept as nearly on the level of the approach as will admit of its being drained and the foot of the splinter proof timber is sunk 12 or 14 inches under it. In this situation an accidental explosion of the magazine will not injure the battery.

When marching, a spot of ground is selected, at the end of the march, in the centre of the park. It should be as dry as possible, well cleaned and drained. Tarpaulins placed on it and the barrels put in horizontal rows on their sides, and the whole covered with tarpaulins.

Transport of Gunpowder.

The transport of gunpowder in India on service, is generally on bullocks in 45lb. barrels. One bullock carries two fixed in a gunny-bag and placed across the saddle. The barrels must first be packed in wax cloth and then gunny sewn over it to preserve the powder from the weather. In marching from station to station, gunpowder may be carried on bandies, packed similarly to that carried on Bullocks, a bandy will carry six 90lb. barrels piled on each other, first 3, then 2, and at the top 1, the whole secured with tarpaulins above and below.

To prevent confusion and delay the nature of each kind of powder should be carefully marked in paint, on the outside of the gunny surrounding each barrel.

MEASURING ORDNANCE AND CARRIAGES.

All guns, howitzers, or mortars, should previously to being measured, be dismounted, the dimensions taken with the vent upwards, and then the piece turned with the vent downwards; the most convenient mode of measuring the trunnions of mortars is by placing them on their muzzles.

The length of a gun or howitzer is from the hind part of the base ring to the extremity of the muzzle, perpendiculars raised at these points sufficiently long to clear the mouldings of the piece, and the distance between them, will be the required length taken with a string, or rule.

The principal dimensions when carriages are required, are the breadth at the trunnions from shoulder to shoulder, and the diameter of the trunnions,—and the principal dimensions when guns are wanted, are the breadth between the cheeks, at the trunnion holes, and the diameter of the trunnion boxes, vide Forms.

These dimensions should be carefully taken with calibre compasses.

In taking the distance from the centre of trunnion boxes, to the centre of the elevating screws, a perpendicular should be raised on the screw transom equal to the height of the screw when the gun is at Point Blank.

To ascertain the position of the Trunnions of Guns.

With a pair of calibre compasses take the vertical diameter of the gun at the trunnions, half this diameter will be the centre of the bore, or axis of the piece.

Take a carpenter's square having one arm divided into inches and tenths, place this arm against the face of the trunnion—the other resting on the upper surface of the piece, then note the number of inches and tenths, cut by centre of trunnion.

The difference between the semi-diameter of the piece, and the distance from upper surface of piece, to centre of trunnions will be the position either above or below the centre of bore, as the case may be.

FORM.

Dimensions of Guns that require Carriages at

Nature of Ordnance.	Marks on the Gun.	Rate of the Piece of Ordnance.		When made.	Number.	Length.								Diameter.											Position of the centre of Trunnion.			Bottom of Bore.			Weight.			Remarks.
						Of the Piece.			From the centre of the Trunnions to the rear part of the base ring.			From the hind part of the base ring to the centre of the Elevating Screw hole taken in line with the metal.		At the Trunnions from Shoulder to Shoulder.			Of the Trunnions.				Of the bore.				At the Axis of the Piece.	Below the Axis of the Piece.		Hemispherical.	Elliptical.	Flat.				
		English.	Bengal.														Right Trunnion.		Left Trunnion.		Taken Vertically.		Taken Horizontally.											
						ft.	in.	ths.	ft.	in.	ths.	in.	ths.	ft.	in.	ths.	in.	ths.	in.	ths.	in.	ths.	in.	ths.		in.	ths.				cwt.	qr.	lb.	

Date.

C. D. *Captain,*
Commanding Artillery.

FORM

Dimensions of Carriages that require Guns at .

Nature of Carriage.	No. and marks.	When made.	From the centre of Trunnion boxes to the centre of elevating screw.			Breadth between the cheeks at the Trunnion Boxes.		Diameter of right Trunnion hole.		Diameter of left Trunnion hole.	
			ft.	in.	ths	in.	ths	in.	ths	in.	ths

Date.

E. F., Captain,
Comg. Artillery.

PROOF OF ORDNANCE.

Iron Guns.

The guns are first examined, as to their proper dimensions, in which in no case more than $\frac{3}{10}$ of an inch variation is allowed, and in the diameter of the bore only $\frac{1}{40}$ from 12 to 6 pounders; but in the position of the bore, $\frac{1}{2}$ inch out of the axis of a piece from a 24 to an 18 pounder, and $\frac{1}{5}$ of an inch from 12 to 6 pounders is allowed. They are then fired twice with the charges at page 92 with one shot, and two high junk wads. They are to be examined with a searcher after each round.

In this examination they must not have any hole or cavity in the bore of $\frac{2}{10}$ of an inch in depth behind the first reinforce ring, or $\frac{1}{4}$ of an inch in depth before this ring.

Brass Guns.

With 9, 6 and 3 pounders the diameter of the bore must not vary more than $\frac{1}{40}$ of an inch, and in no dimensions more than $\frac{2}{10}$ of an inch.

The following are the established charges for their proof, 3, 6 and 9 pounders light, each round, 2 shot, and 3 wads with the charges, at page 109, the two former 3 and the latter 2 rounds.

Any hole ·15 of an inch deep, upwards or sideways in the bore, or ·1 of an inch in the bottom, between the breech and first reinforce; or ·2 of an inch upwards or sideways, or ·15 of an inch in the bottom of the bore, before the first reinforce ring will be sufficient to condemn them.

Brass Mortars and Howitzers.

The exterior dimensions are in no respect to deviate more than $\frac{1}{20}$ of an inch.

Their bores and chambers not to deviate from their true diameters or positions more than $\frac{1}{40}$ of an inch.

The brass mortars and howitzers are fired twice with chambers full of powder, and an iron shell. The mortars on their beds at about 75 degrees elevation, and the howitzers on their carriages at about 12 degrees. Mortars and howitzers having a hole of ·1 of an inch in depth in chamber or ·15 of an inch in the chase are rejected.

Iron Mortars.

Iron mortars are proved on their iron beds, with a charge equal to the full chamber, and an iron shot equal in diameter to the shell at 75 degrees elevation, two rounds.

New Bouched Ordnance.

Every gun and howitzer after being new bouched, to be proved by six rounds with full charge of Powder, and a round shot or shell fired from it.

A Mortar by three rounds, chamber half full, with a shell.

All Ordnance after having undergone these proofs and the subsequent searchings, are subject to the water proof. This is done by means of a forcing pump, having a pipe or hose fixed to the mouth of the piece after two or three efforts to pass the water through any honey combs, or flaws, which may be in the bore, they are left to dry, and generally the next day examined by the reflected light from a Mirror. If the bore contains any small holes or flaws which have not been discovered by the former proofs, they are very readily found by this, as the water will continue to weep or run from the holes when the solid parts of the bore are perfectly dry.

Ordnance suspected of being bad are often subjected to a more severe proof; that of firing 20 rounds quick with a charge equal to shots weight, and 2 shot; and in doubtful cases where the purity of the metal is suspected, recourse has been had to chemical trials and analysis. A quantity of clean filings taken from a part of an Iron Gun free from rust, are dissolved in diluted sulphuric acid, and the quantity of gas, disengaged during the solution accurately ascertained. The Plumbago which remains after solution is also separated by filtration and carefully weighed. Now it is well known that the purer the Iron, the greater the quantity of inflammable gas obtained, and the less is the proportion of Plumbago which remains after the solution from these two parts, therefore a tolerable judgment may be formed of the quality of the metal, when the Plumbago exceeds 4½ per cent, the iron will always be found deficient in strength, and there has been no instance of a gun bursting where the Plumbago did not exceed 3 per cent; that is where one hundred grains of the metal did not leave more than three grains of Plumbago.

The color of the Plumbago, is also to be attended to. When it is brown or reddish, it is an indication of hard metal, and when in quantities and mixed with coals there can be no doubt but that the iron is too soft for cannon.

When proving guns, they should be dismounted, placed on the ground, a skid under the muzzle to raise them a little for the convenience of loading. Then pointed into a butt or against some object to insure the shot being recovered, guns, mortars and howitzers, should have a piece of port-fire 2 inches long fixed on the vent with clay or any thing that will keep it steady, to allow the men to get out of the way before the explosion takes place to avoid accidents —vide Form.

FORM

Report of a Proof of Ordnance, at   on the

Brass Guns.									Powder.													Round Shot No.				Height the first charge measured.			Vertical diameter of bore at muzzle.		Horizontal diameter of bore at muzzle.		On the Returns			Recoil.		Remarks	State of the Proof.		
Distinguishing mark.	Number.	Length.		Weight.			Nature.	When made.	For Scaling.		For Priming.		Charge.						Total quantity used.			Firings.			Total.	feet	ins.	tens.	ins.	ths.	ins.	ths.	Serviceable.	Repairable.	Unserviceable.	feet	ins.		Serviceable.	Repairable.	Unserviceable.
		feet	ins.	cwt.	qrs.	lbs.			lbs.	oz.	lbs.	oz.	1st.		2d.		3rd.		90 lbs. barrel.	lbs.	oz.	1st.	2d.	3rd.																	
													lbs.	oz.	lbs.	oz.	lbs.	oz.																							

J. K., Major,
Commanding Artillery.

G. H., Lieut.,
Superintending.

PROOF OF GUN CARRIAGES AND MORTAR BEDS.

The following proof is established for Ordnance Carriages and Mortar Beds.

For Gun Carriages heavy and light, 15 rounds per Carriage full service charge with one shot.

5 rounds	at point blank.
5 „	at the medium elevation.
5 „	at the greatest elevation the carriage will admit of

For Howitzer Carriages, 15 rounds with a dead shell.

5 rounds	at point blank.
5 „	at the medium elevation.
5 „	at the greatest elevation the carriage will admit of.

Charges.

					lb.	oz.
10 inch	Iron	Howitzer			7	0
8 „	„	„			3	8
5½ „	Brass	„	heavy		2	0
24 Pdr.	„	„	„		2	8
24 „	„	„	light		2	0
12 „	„	„	„		1	4

For Mortar Beds.

5 Rounds each Bed, chamber two-thirds full at 60 degrees elevation with a dead shell.—Vide Form.

When proving carriages at the highest elevation, the breech of the gun or howitzer, should not be allowed to touch the cheeks.

FORM

Report of Proof of the undermentioned *on the*

Nature of Bed or Carriage.	No. of Beds or Carriages.	No. of Firings.	Nature of Powder.	Marks and No. on the Bed or Carriage.	Marks and No. on the Mortar or Gun.	Weight.											Diameter.				Medium Flight.		Elevation.		Medium Recoil.		Medium Distance.		Remarks.
						Metal.			Bed or Carriage.			Charge.			Shell or Shot.		Bore.		Shell or Shot.										
						cwt.	qrs.	lbs.	cwt.	qrs.	lbs.	lbs.	oz.	drs.	lbs.	oz.	in.	ths.	in.	ths.	S.	P.	D.	M.	feet	in.	yds.	feet	

Station and Date.

O. P., Major,
Commanding Artillery.

L. M., Lieut.
Superintending.

DIRECTIONS FOR ASCERTAINING THE STATE OF ORDNANCE.

The established sized vent for all pieces of ordnance is ·2 of an inch.

Should the vent be increased to ·4 or double in diameter, the piece should no longer be used in that state, but *bouched.*

Although there may be no great danger in firing a piece, with the vent so enlarged, provided it be not honey combed, still so considerable a portion of the charge would escape by this orifice, as to materially affect the velocity of the projectile, particularly in mortars, where so much nicety is required in regulating the charge.

When the vent is honey-combed or full of little cavities, the danger from firing is great, from fire lodging in these cavities, and not being extinguished in spunging; any cavity ·1 of an inch in depth in the vent, or a number of small cavities, should render the piece unserviceable (*till bouched.*)

To ascertain the state of the vent, take a brass or iron pricker about half the size of the vent, bend the point at right angles to the wire ·1 of an inch in length, with this wire feel every part of the vent, this will give the depth of cavities, and shew whether they are numerous, by being worked about it in all directions, and will enable a tolerable correct judgment to be formed of its enlargement.

The rays of the sun reflected from a mirror will render the bottom part of the vent visible.

The bores of ordnance, particularly short pieces such as mortars, should be frequently examined, by taking the vertical and horizontal diameters with calibre compasses, at the mouth of the chamber, and a few inches within the muzzle, not at the muzzle itself as with heavy shells it frequently happens on letting them into the piece they strike the surface and dent it.

Independent of the incorrectness of the flight of the projectile in passing through an uneven bore, any enlargement of it adds to the windage, allows a greater quantity of the elastic fluid to escape, and consequently diminishes the range of the projectile.

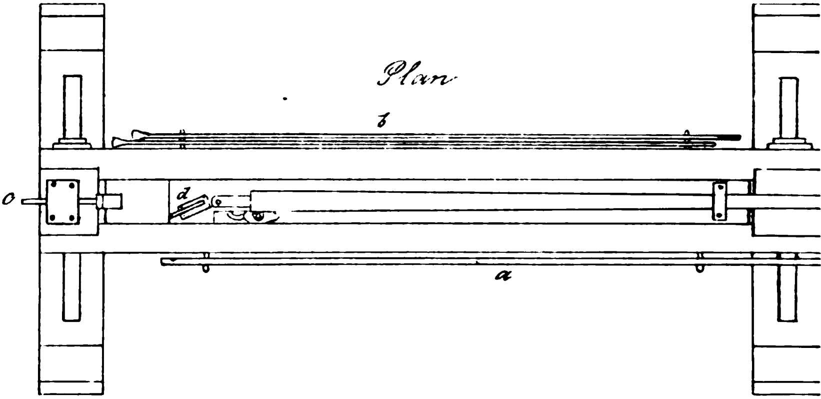
Table of diameter of Bores, Windage of Ordnance and Diameter of Shot and Shells.

Nature of Ordnance.		Diameter of bore.	Diameter of Shot and Shells		Windage.			Windage sufficient to condemn a piece of ordnance.	Diameter of bore by which Guns are to be considered unserviceable.
			Maximum.	Minimum.	Minimum.	Medium.	Maximum.		
		inch.	inch.	inch.	inch.	inch.	inch.	inch.	inches
Carronades.	68 Pdr.	8·05	7·95	7·85	.1	·15	·2	·3	8·35
	42 do.	6·84	6·795	6·729	·045	·078	·111	·156	6·996
	32 do.	6·25	6·207	6·147	·013	·073	·103	·146	6·396
	24 do.	5·68	5·639	5·584	·011	·0685	·096	·137	5·817
	18 do.	5·18	5·124	5·074	·056	·081	·106	·162	5·342
	12 do.	4·52	4·476	1·432	·044	·066	·088	·132	4·652
	9 do.	4·14	4·1	4·06	·04	·06	·08	·12	4·26
	6 do.	3·6	3·568	3·532	·032	·05	·068	·1	3·7
Guns........	68 do.	8·05	7·95	7·85	·1	·15	·2	·3	8·35
	42 do.	7·018	6·795	6·729	·223	·256	·289	·512	7·530
	32 do.	6·41	6·207	6·147	·203	·233	·263	·466	6·876
	24 do.	5·823	5·639	5·584	·181	·2115	·239	·423	6·246
	18 do.	5·292	5·121	5·074	·168	·193	·218	·386	5·678
	12 do.	4·623	4·476	4·432	·147	·169	·191	·338	4·961
	9 do.	4·2	4·1	4·06	·1	·12	·14	·24	4·44
	6 do.	3·668	3·568	3·532	·1	·118	·136	·236	3·904
	3 do.	2·913	2·833	2·803	·080	·095	·11	·190	3·103
Mortars & Howitzers.	13 inch.	13·0	12·88	12·80	·12	·16	·20	·32	13·32
	10 do.	10·0	9·88	9·80	·12	·16	·20	·32	10·32
	8 do.	8·0	7·95	7·85	·05	·10	·15	·20	8·20
	5½ do.	5·66	5·62	5·57	·04	·065	·09	·130	5·790
	4⅖ do.	4·52	4·476	1·432	·044	·066	·088	·132	4·652
	24 pdr.	5·66	5·62	5·57	·04	·065	·090	·130	5·790
	12 do.	4·52	4·476	1·432	·044	·066	·088	·132	4·652

There is a maximum and minimum size of each nature of Shot and Shell, the difference between the two dimensions, being the limit allowed to the Founder in casting. The greatest and least Windage therefore is found by deducting the maximum or minimum, from the diameter of the bore, but taking a medium of the two from the diameter of the bore, shews more properly the true Windage.

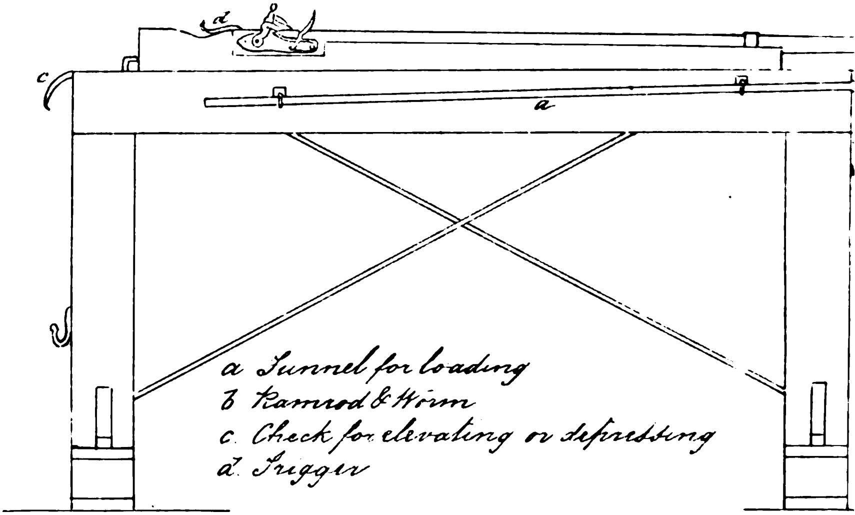
Art

Fuzil & Boards for



Plan

fig 66



Elevation

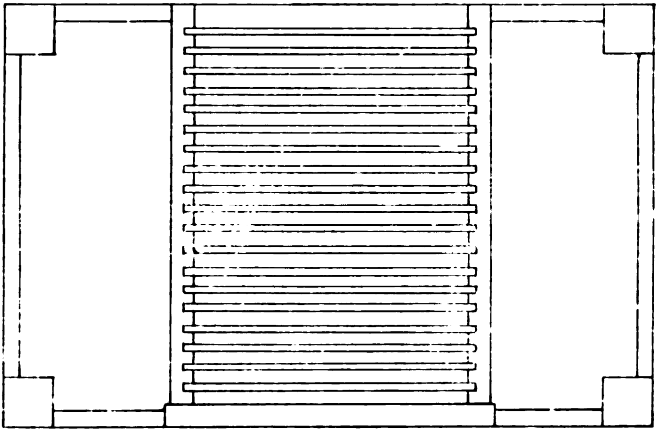
a Funnel for loading
b Ramrod & Worm
c Check for elevating or depressing
d Trigger

Scale 1 inch to a foot

llery.

Proving Powder.

Plan



Elevation

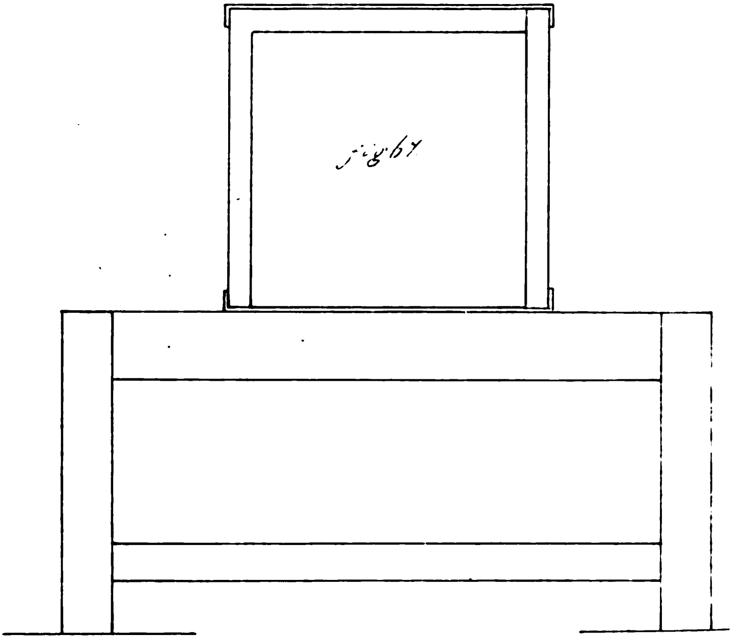
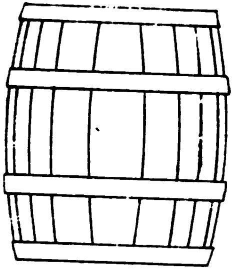


fig 67

Powder Barrells.

fig. 68

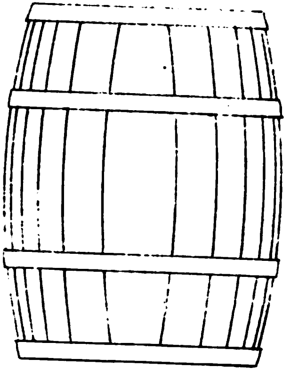
45 ℔.



Weight 21 lbs.

fig. 69

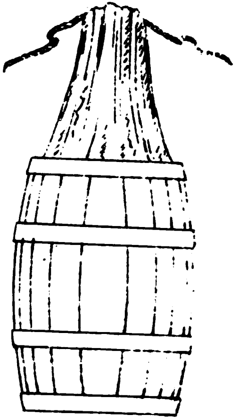
90 ℔



Weight 33 lbs.

fig. 70

Budge

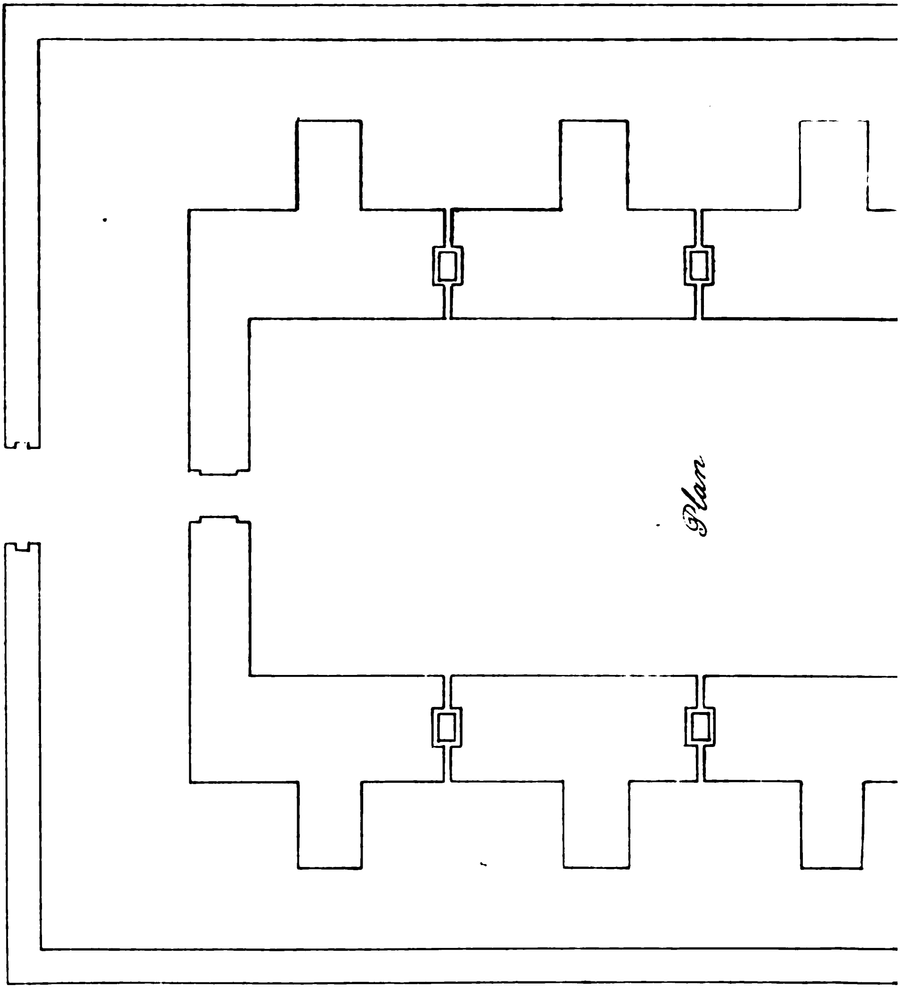


Weight 16 lbs.

Art

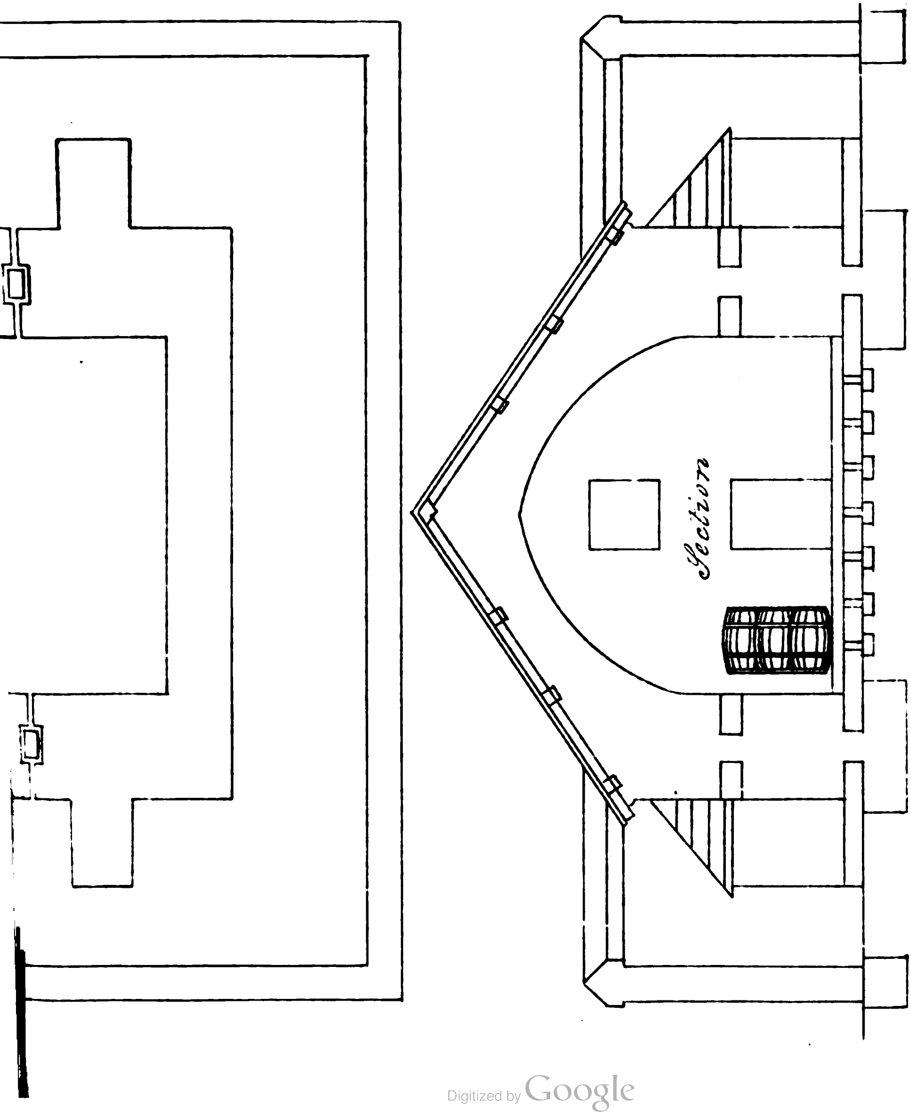
Powder.

Fi



llery.

agazine.



CONDEMNED ORDNANCE.

Ordnance condemned as unserviceable for any of the reason noticed in page 176 are marked as follows: XD, or XS, or XW. The first signifies that they are found to be faulty in their dimensions by Desagulier's instrument, the second by the searcher, and the third by the waterproof.

All iron guns which may be finally condemned, should be burst if practicable, or the trunnions broken off.

Guns and howitzers may be entirely destroyed, or only rendered unserviceable for a short period.

To destroy Guns, &c.

The surest method is, to burst the piece, which is done by loading it with a double charge of powder, the shot is then to be rammed home tight on the cartridge, and fixed by small coins of wood or iron, it is primed with a piece of portfire, to which must be fixed a piece of match, sufficiently long, to enable the person firing, to get under cover. It is said, that a charge of powder, with dry sand loosely poured into the gun standing upright, and fired, is almost certain of bursting it in every case.

Should these methods not succeed, the bore of the piece is so much injured, that it may be considered as unserviceable. If the charge is fired from the muzzle, and the gun is laid horizontally under ground, it will never fail bursting.

With brass guns, place their muzzles upwards, and knock off one or both trunnions with a sledge hammer.

Brass guns may be destroyed in the following manner. Build a mud enclosure, lay the gun horizontally on iron axletrees, or other supports, fill it with wood and bratties, which set on fire, and in about 4 hours, the piece will be red hot, take it out and beat it with hammers, when it will fall to pieces.

To render Guns unserviceable.

An excellent method of rendering guns unserviceable, is to break or bend its trunnions, to effect this, heat the piece to soften the metal, then place it so, as to rest only on its trunnions, and either let fall a heavy body on it, or strike it with a hammer.

Fire a shot from one piece, into the bore of another, which will damage the gun.

To render guns unserviceable for a short period.

This is effected, by driving an iron spike into the vent, and if iron ones are not at hand, a wooden peg even, will render a gun unserviceable for a short time. If neither spikes nor pegs are at hand, send a shot home without powder, and fix it with iron or wooden wedges.

To deprive the enemy of the use of the guns momentarily abandoned, carry away the elevating screw, spunges, &c.

To spike a gun properly, use a spike the head and middle of which are highly tempered, and the end not so. Force this into the vent as far as it will go, break it level with the upper surface of the piece, and rivet the end inside by means of the rammer head, thus spiked, neither gunpowder nor boring will be effectual in removing the spike.

To restore guns which have been rendered unserviceable.

If the gun has a shot fixed in the bore by coins, dissolve the charge by pouring through the vent, vinegar or hot water ; ram home the shot, which will relieve it from the coins, when it may be easily withdrawn. Should the shot be put in without powder, a little of the latter must be poured in through the vent, and fired ; when the shot most likely will be moved, and if not entirely driven out, the operation must be repeated.

If spiked, load it with the regular charge and fire it from the muzzle ; if by this means you do not entirely get rid of the spike, you may so shake it, as to render it easily removable. However, if guns have been well spiked, it is seldom they can be rendered perfectly serviceable without putting in a new bouche.

To render mortars unserviceable.

Mortars may be rendered unserviceable by breaking off the trunnions, or bursting shells inside the bore.

GUAGES.

All shot or shells should be carefully guaged, either when received into, or issued from magazines; and also previous to practice: they should pass through the high, and not through the low guage. It is also advisable when sent on service, that they should undergo *actual* guage with the ordnance for which they are intended.

There are two guages for each shot and shell, one marked H for high, and the other L for low.

These guages are made to correspond with the decrease in windage, ordered by the Board of Ordnance in September 1825, there being a minimum and maximum for each projectile, as given in the following table.

Table of Guages.

Round Shot.			Shells common, and spherical, by Pounders.		Shells for Mortars, and Howitzers, by Inches.		
Pdr.	High.	Low.	High.	Low.	In.	High.	Low.
68	7·95	7·85	same as shot	some as shot	13	12·88	12·8
48	6·795	6·729	do.	do.	10	9·88	9·8
32	6·207	6·147	do.	do.	8	7·95	7·85
24	5·639	5·584	5,62	5,57	5½	5·62	5·57
18	5·124	5·074	same as shot	same as shot	4⅖	4·476	4·432
12	4·476	4·432	do.	do.			
9	4·1	4·06	do.	do.			
6	3·568	3·532	do.	do.			
4	3·124	3·053					
3	2·833	2·803					
2	2·484	2·423					
1	1·969	1·923					

Shot are not to be condemned as unserviceable from wasting away, till they pass through the low guage.

PILING SHOT AND SHELLS.

Iron shot and shells are commonly piled by horizontal courses, either in a pyramidal or a wedge-like form, the base being either an equilateral triangle, a square, or a rectangle. In the triangle and square, the pile finishes in a single ball; but in the rectangle, it finishes in a single row of balls like an edge.

In triangular and square piles, the number of horizontal rows or courses, is always equal to the number of balls in one side of the bottom row. And in rectangular piles, the number of rows is equal to the number of balls in the breadth of the bottom row; also the number in the top row or edge, is one more than the difference between the length and breadth of the bottom row.

To find the number of Shot, or Shells, in a complete Pile.

Add the three parallel edges into one sum, then $\frac{1}{3}$ the product of that sum, and of the number of balls in the triangular face, will be the number sought.

Note 1.—The parallel edges in a rectangular pile, are the two rows in length at the base, and upper ridge. In the square pile the same, except, that the upper row here is only a single ball. In the triangular pile, one side of the base, the single ball at the top, and that at the back are considered the parallel edges.

Note 2.—The number of balls in the triangular face, is found by multiplying half the number in the breadth at the base, by the number in the breadth of the base, plus one.

To find the number in a broken, or incomplete Pile.

Compute the number in the Pile considered as complete, and also the number in the upper pile, or part wanting to complete it, and the difference between the two piles thus found, will be the number in the frustrum or incomplete pile. When the number of balls in the base of any pile does not exceed 21, much time and trouble will be saved by making use of the following Table.

Table for computing the contents of any Pile, whose base line does not exceed 21 Balls.

1	II	4																				
2	5	III	10																			
3	8	14	IV	20																		
4	11	20	30	V	35																	
5	14	26	40	55	VI	56																
6	17	32	50	70	91	VII	84															
7	20	38	60	85	112	140	VIII	120														
8	23	44	70	100	133	168	204	IX	165													
9	26	50	80	115	154	196	240	285	X	220												
10	29	56	90	130	175	224	276	330	385	XI	286											
11	32	62	100	145	196	252	312	375	440	506	XII	364										
12	35	68	110	160	217	280	348	420	495	572	650	XIII	455									
13	38	74	120	175	238	308	384	465	550	638	728	819	XIV	560								
14	41	80	130	190	259	336	420	510	605	704	806	910	1015	XV	680							
15	44	86	140	205	280	364	456	555	660	770	884	1001	1120	1240	XVI	816						
16	47	92	150	220	301	392	492	600	715	836	962	1092	1225	1360	1496	XVII	969					
17	50	98	160	235	322	420	528	645	770	902	1040	1183	1330	1480	1632	1785	XVIII	1140				
18	53	104	170	250	343	448	564	690	825	968	1118	1274	1435	1600	1768	1938	2109	XIX	1330			
19	56	110	180	265	364	476	600	735	880	1034	1196	1365	1540	1720	1904	2091	2280	2470	XX	1540		
20	59	116	190	280	385	504	636	780	935	1100	1274	1456	1645	1840	2040	2244	2451	2660	2870	XXI	1771	
21	62	122	200	295	406	532	672	825	990	1166	1352	1547	1750	1960	2176	2397	2622	2850	3080	3311	XXII	2024
CD	3	6	10	15	21	28	36	45	55	66	78	91	105	120	136	153	171	190	210	231	253	276

Rules for using the Table.

1. *For the square pile.*

Required the contents of a square pile, the number in the base being 20.

Look for the number 20 in the first vertical column on the left hand, and also in the diagonal column of roman figures and at their angle of meeting will be found the contents required, viz. 2870.

2. *For the rectangular pile.*

Required the contents of a pile, the breadth being 12, and length 17.

Look for 17 in the vertical, and 12 in the diagonal column of roman figures, and at their angle of meeting will be found 1040 the contents required.

3. *For the triangular pile.*

The number of shot in the base row being 18, required the contents.

Look for 18 in the diagonal column in roman figures, and opposite to it outwards, will be found 1140 the contents.

The horizontal column at the bottom of the table marked CD. is the graduation, or common difference of the several piles, and the differences of its terms from the arithmetical progression, 3, 4, 5, &c. &c.

Preservation of Shot and Shells.

It is important, that shot be protected as much as possible from those vicissitudes, and from that treatment, which are continually operating to diminish their size, and consequently to increase the windage. Several methods to obtain this object have been adopted, such as covering them with a coat of red lead or coaltar; but the best is, to keep them piled on raised platforms, with sheds over them, to preserve them from the effects of the weather.

When shot have been a long time covered with mud or dirt of any kind, it should be carefully rubbed off, and not beaten off with hammers.

If the rust is hard and thick, they must of necessity be placed in the cleaning machine.

Machine for cleaning shot.

This machine, the invention of Mr. Cheetham, Deputy Storekeeper in the Royal Arsenal at Woolwich, was sent to India by the Court of Directors in 1827. Its introduction into the different arsenals was strongly recommended, not so much for the time and labor saved in cleaning shot, as for the uniformity of the rotary motion by which every part of the shot is equally acted on. Too many shot should not be put in at one time, as it renders the turning of the machine very laborious.

The following number of each kind, at one time, is recommended, and about 350 turns will be found sufficient.

Memorandum for cleaning shot.

Nature.	Number in Machine.	Time.	Number of revolutions.	Number of Lascars.	REMARKS.
24 Pdr.	6	7 min.	310	4	If required to work any length of time, there must be relays of Lascars.
18 „	8	9 „	370	4	
12 „	12	7½ „	350	4	
9 „	16	5 „	200	4	
6 „	24	9 „	350	4	

This operation should not be too frequently repeated, or it would reduce the magnitude of the shot, and increase the windage, so as to render them unserviceable.

REGULATIONS RESPECTING WEIGHTS AND MEASURES.

All articles of Military Stores received from Europe, which require being brought to account by weight, are received, issued, and returned ,by avoirdupois weight; and such liquid or other articles as require being brought to account by measure, are received, issued, and returned, by English measure, according to the tables hereafter entered.

All articles of Military Stores the produce of India, that are to be brought to account by weight, are received, issued, and returned, by Country weights ; and all liquid and other articles to be brought to account by measure, are received, issued, and returned, by Country measure, agreeably to the following tables.

Gunpowder whether manufactured in the country, or otherwise, is accounted for, by barrels, and pounds, avoirdupois.

English Weights and Measures.

Avoirdupois Weight.

16	Drams	1 oz.
16	Ounces	1 lb.
28	Pounds	1 Quarter.
4	Quarters	1 Cwt.
20	Cwt	1 Ton.

Liquid Measure.

4	Gills	1 Pint.
2	Pints	1 Quart.
4	Quarts	1 Gallon.
36	Gallons	1 Barrel.

Superficial Measure.

10	Tenths	1 Inch.
12	Inches	1 Foot.
30	Inches	1 Pace.
3	Feet	1 Yard.
2	Yards	1 Fathom.
220	Yards	1 Furlong.
8	Furlong or 1760 yards	1 Mile.

COUNTRY WEIGHTS AND MEASURE.

Weights.

			℔	oz.	drs.
10 Pagodas weight....	1 Pullum	or	0	1	4
40 Pullums..........	1 Viss	or	3	2	0
8 Viss...............	1 Maund	or	25	0	0
20 Maunds...........	1 Candy	or	500	0	0

LIQUID MEASURE.

		gall.	qts.	pts.	gill.
1 Ollock....................		0	0	0	$1\frac{1}{5}$
8 Ollocks........	1 Measure..	0	1	1	$\frac{4}{5}$
8 Measures........	1 Maund...	3	0	1	2
2 Maunds........	1 Candy..	64	0	0	0

MISCELLANEOUS ARTICLES.

	gall.	qts.	pts.	gill.
2½ Measures or 20 Ollocks....	1	0	0	0
5 Ollocks.................	0	1	0	0
2½ Ollocks.................	0	0	1	0

3 Bushels.....................One Parrah.
6 Soops.........................One Bushel.
18 Soops.........................One Parrah.

1 Marcul is one Maund, or 8 Measures, or 12 Seers.
1 Barrel of Tar.............30 to 33 Gallons.
1 „ of Grease..............36 „
1 Tierce is.....................42 „

1 Keg for Tar or Grease should contain 4 Gallons.
1 Dupper.....................15 Gallons.

	cwt.	qrs.	lbs.		cwt.	qrs.	lbs
1 Pig of lead from......	1	0	11	to	1	2	6

1 Skein of mer line................ 32 Fathoms.
1 Skein of Log line................ 30 „
1 Coil of Europe rope contains.......120 „
1 Coil of country coir rope...........100 „

1 Parrah mea. is 24 inch. square and 6 inch. deep, for chunam.
Do. do. 27 „ „ „ 12 „ „ „ charcoal.

CLOTH IS MEASURED BY CUBIT of 18 Inches.

1	Piece of Long cloth should be............	70	Cubits.
1	„ Tent „ white should be.......	18	„
1	„ „ „ blue „	30	„
1	„ waxed „ „	18	„
1	„ Bittelas „ „	12½	„
1	Bolt of Europe Canvas contains from	76 to 78	„
1	„ Bengal „ „ „	72 to 80	„
1	Piece of colored serge double contains from	120 to 123.	
1	do. „ single „	48 to 50.	
1	do. white „ „	58 to 60.	

Table *of the Specific Gravity and Weight of a Cubic Foot of various substances.*

Name of the substance	Specific Gravity.	Weight of a Cubic foot in Pounds.	Name of the substance	Specific Gravity.	Weight of a Cubic foot in Pounds.
Bee's wax yellow - -	.965	60.31	Iron bar from....	7·600	475·00
Brass, (wire drawn) -	8.514	534.00	Iron bar to.......	7·800	487·50
„ Plate ------	8.44	527.56	„ Hammered	7·763	585·18
„ Cast -- - - ---	8.100	506.25	„ not Hammered	7·600	475·00
Chalk from......	2.315	144.68	„ Cast from...	7·600	475·00
Chalk to........	2.657	166.06	„ Cast to	7·200	450·00
Charcoal from Birch -	.542	33.87	„ horizontal ...	7·113	444·56
„ Fir --------	.441	27.56	„ vertical casting	7·074	442·12
„ Oak --------	.332	20.75	Lead, milled	11·407	712·93
„ Pine -------	.280	17.50	„ cast..........	11·352	709·50
Copper, British sheet	8.785	549.06	„ black.........	2·267	141·68
„ „ cast	8.607	537.93	Pewter.............	7·248	453·00
Earth common from	1.520	95.00	Pitch...............	1·150	71·87
Earth common to....	1.984	124.00	Steel... from......	7·780	486·25
„ loamy or strong	2.016	126.00	Steel... to........	7·840	490·00
„ rammed -----	1.584	99.00	Sulphur,...........	1·810	
„ loose or sandy -	1.520	95.00	Tar.................	1·015	
Firestone --------	1.800	112.50	Tin hammered.......	7·299	456·18
Flint from......	2.580	161.25	„ pure cast	7·291	455·68
Flint to........	2.630	164.37	Teak dry from....	.832	52·00
„ black Cambridge	2.592	162.00	Teak dry to.......	·745	46·56
Gun metal -------	8.784		„ seasoned.......	·657	41·06
Gunpowder solid ---	1.745	109.06	Zinc........	7·028	439·25
„ shaken --	.922	57.62			
„ in a loose heap -	.868				

To find the magnitude of any body from its weight, by the common rule of three.

As the tabular specific gravity of the body,
Is to its weight in avoirdupois ounces;
So is one cubic foot or 1728 cubic inches,
To its contents in feet or inches respectively.

To find the weight of any Body from its magnitude, also by the rule of three, say

As one cubic foot, or 1728 cubic inches,
Is to the contents of the body;
So is the tabular specific gravity,
To the weight of the body in ounces.

TONNAGE.

The usual method of finding the Tonnage of any ship is by the following rule.

Multiply the length of the keel by the breadth of the beam, and that product again, by half the breadth of the beam; then divide this last product by 94, and the quotient will be the tonnage.

Ships keel 72 feet, breadth of beam 24 feet.

$$\frac{72 \times 24 \times 12}{94.} = 220{\cdot}59.$$

The Tonnage of goods and stores is taken sometimes by weight, and sometimes by measurement, and that method is allowed the vessel, which yields the most Tonnage.

In Tonnage by weight, 20 cwt. make 1 Ton. In Tonnage by measurement, 40 cubic feet are equal to 1 Ton.

Multiply the length, breadth, and thickness, in inches together, and divide by 1728, (the number of inches in a cubic foot) and that quotient divide by 40, (the number of cubic feet to one Ton) gives the number of Tons.

All ordnance whether brass or iron, musket cartridges in boxes or barrels, all ammunition in boxes, and other articles of great weight, are taken in Tonnage according to their actual weight.

All carriages or other stores to be measured for tonnage, are to be taken to pieces and packed in the manner which will occupy the least room on board ship.

ARTILLERY.

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MACHINES, &c.

MACHINES

FOR

MOUNTING AND DISMOUNTING,

AND FOR

MOVING AND TRANSPORTING

HEAVY ORDNANCE.

LEVER AND HANDSPIKE.

The lever is of most essential use in the service of Artillery; when it is six feet long, and three and a half inches square at the large end called the *point*, it is termed a handspike.

The lever may be of any length; but the longer it is, the greater will be its power.

The lever in mechanics is of three different kinds; two, however, are only applicable to the Artillery.

The lever of the first kind is, when the weight to be raised or moved is at the point of the handspike, the power at the other end, and the prop or fulcrum between both; this is best exemplified by raising the breech of a gun mounted on a garrison carriage; the large end or point of the handspike is placed under the breech or weight, the spot on which the handspike, (viz. the cheek of the carriage) is the fulcrum or prop, and the power is at the small end; the part between the small end and the prop or fulcrum is called the lever, and that comprehended between the fulcrum and point the counter lever: in proportion as the counter lever is shorter, the greater will be the effect produced; that is, the greater the facility in lifting the weight, and the nearer the power is applied to the fulcrum, the greater the difficulty of raising it; consequently the men must be taught to bear down at the small end with both hands close together.

The foregoing principle must also be exhibited to the men, with a gun dismounted or upon skids, and to enable them to feel as it were the truth of it; a gun of light calibre should be used, and quoins or pieces of wood as fulcrums, placed at different distances from the piece, in order to raise the breech or muzzle, and by placing the hands at different distances from the small end of the handspike.

The lever of the second kind. is when the prop or fulcrum is at one end of the handspike, the force or power at the other end, and the weight to be raised or moved between them.

When guns or mortars are run up or back it is upon this principle; the point of support or fulcrum is the large end or point of the handspike resting on the platform; the counter lever is the distance from this point to that part of the handspike, touching the axletree or running up bolts, and the lever the whole length of the handspike which is heaved up.

Here the counter lever being very short, less force is required to impel the body forward, its progress is however less; so that, what is gained in power is lost in time.

Crossing two handspikes in opposite directions under the breech or chase and heaving up, is an application of the second kind of lever.

When a gun is made to move on its trunnions by means of a handspike, the greater distance it is placed from the trunnions, the easier the operation will be performed.

Though in many operations of Artillery it is best that the point of the handspike should be square, yet for many others it is beneficial to have one side bevelled off in the proportion of five-eighths of its thickness, and to three or four inches, and sometimes more, of its length; this is necessary in order that it may enter into places and under bodies, which when square pointed it could not do.

When the point is bevelled, and the handspike used as a lever of the first kind, the weight should never rest on the bevelled side, for it would only be resisted by three-eighths, or one-half of the thickness, besides it would be liable to split, applied as a lever of the second kind, the bevelled side of the handspike must be uppermost.

SLEWING.

Slewing a gun or mortar, is, properly speaking, turning it round on its axis, on the spot on which it rests; it is an indispensable operation when mounting guns on their carriages by par-buckling.

If the gun to be slewed rests on skids or rollers, a handspike is placed bevelled side up on each skid close to the gun, and always on that side of it towards which the upper surface is to be turned; this is called scotching or chocking.

Should the gun or mortar not have dolphins, which is the case with all English iron guns, a piece of rope will do equally well, by fastening the ends together by a sheet bend, or right knot, so as to form it into strap of a proper length, one bight of which is placed under one of the trunnions and a handspike passed through the other bight, the point of it bearing on the upper surface of the piece.

When there are no dolphins to a mortar, the rope formed into a strap is laid over the proper trunnion, one bight of the strap is then passed through the other bight, and hauled taught; after which the strap is brought under the mortar behind the breech and up on the other side in front of the trunnion, and the slewing handspike applied as before.

The term slewing also applies to turning round horizontally a gun or mortar, which rests on some point or pivot.

If the gun be on the ground, the chase is to be raised and a piece or block of wood about 5 or 6 inches thick, and one, or one and a half foot long, is placed under the gun behind the trunnions, just at the centre of gravity of the piece ; a handspike placed in the bore and borne down upon, will bring the gun horizontal; the gun may then be turned round, a man on each side checking it with a handspike, so as to prevent its falling off the piece of wood.

To slew a mortar which is lying on the ground, so as to bring the muzzle where the breech was; place a handspike in the bore, and two or more men, by the joint application of pushing and hauling on it, will slew the mortar.

In the foregoing operations, it may be necessary to steady the gun or mortar, by handspikes placed in the dolphins, or through straps applied to the trunnions.

To slew a mortar resting on the muzzle, two handspikes are placed horizontally, one in front of one trunnion, the other in rear of the other, and in their prolongation, the points touching the shoulders; they are to be secured by several turns of lashing rope passed round close to the ends of the trunnions, and the men to be placed at each handspike so as to haul it towards them.

PINCHING.

Pinching is the operation of moving a gun or mortar forward, without allowing it to turn on its axis, by small heaves of the handspike, whereby the body is moved little by little, and in its progress is never lifted up, but rubs against the skid on which it rests.

The gun being on skids and it being necessary to move it bodily (sideways), a handspike is placed as in slewing to steady the gun; two handspikes are then placed on the same side and on the skids, bevel side under, and as close to the gun as possible; bearing down on them will have the effect of making the gun advance horizontally without turning.

The breech or muzzle may be pinched separately or alternately, recollecting that when the breech is pinched forward, the checking handspike must be at the opposite side of the chase, and when the muzzle is pinched forward at the opposite side of the breech.

Moving a gun bodily in the direction of the axis, is also called pinching or rowing; the handspike is used on the first principle, resting on a fulcrum; its direction when applied, must always form an angle with the axis; the small end to be on that side to which the body is to be moved; handspikes are required on each side of the piece, and whatever number of them are employed, the men must act together, or little, or indeed no effect will be produced; when every thing is ready the men bear down the small end of the handspike, and move it horizontally to the other side; this will cause the piece to move in the direction intended.

CROSS LIFTING.

Cross lifting is the moving a gun or carriage, to the right or left, in a direction nearly perpendicular to the axis.

If the handspikes be used on the first principle, with a fulcrum, their application is exactly as that for pinching or rowing a gun.

But if on the second principle the point of the handspike bearing on the ground, the small end of the handspike with respect to the axis of the piece, is to be on the contrary side to that, to which the body is to be moved, in this case, the small end of the handspike is heaved up, and carried over to the other side. No. 1 applies his handspike in this manner, under the trail of a carriage, when it is run up in battery, and when he wishes to move it to the right or left to keep the gun in a proper direction. Should the body be heavy, and there be sufficient room, two or three handspikes may be applied and act together.

The distance the body will be carried in the intended direction will depend on the length of the counter lever. Heavy guns mounted, always require a lever, with a fulcrum of a proper length, for cross lifting: but light guns mounted, are cross lifted by hand, some men being posted to the breast of the carriage, and others at the wheels, who take hold of such spokes, as may be horizontal.

The common handspike is managed by one man; but a lever, according to its length, or weight, requires two or more.

With two men, 3 adjusts the fulcrums, and places the point of the lever under the gun, or carriage; 2 manages the small end, and bears down, assisted by 3, if necessary.

If two levers be used, 2 and 4, on their respective sides, manage the small end, and 3, 5 place the fulcrums.

With six men, 2, 3 manage the small ends, 4, 5 places the points under the gun or carriage, and 6, 7 the fulcrums; they all bear down if necessary.

SECTION II. ARTILLERY GIN.

The Madras Artillery Gin for Field Ordnance, has legs of 16 feet in length, and for the facility of transport, is made to take to pieces.

Names and weights of the different parts.

	lbs.	oz.
2 Cheeks	403	„
1 Pry Pole	177	„
1 Fall or rope	90	„
1 Triple Block 1 Double do.	212	„
1 Windlass	271	„
1 Upper Cylinder	130	„
1 Lower Cylinder with handles	156	„
1 Tackle loop and bolt	65	„
2 Cross bars	122	„
3 Shoes	52	„

The following articles are required for the use of the Gin.

1 Triple Block.

1 Double do.

1 Fall of 4½ inch rope, and 120 feet long.

Slings, made of 6 inch rope, are of different sizes, according to the nature of the gun or howitzer—Fid, for which a handspike or two may be substituted, for howitzers a large piece of wood or short piece of skidding.

2 lashing ropes 2½ inch, three fathoms each, for lashing the slings, or slinging mortars, &c.

1 piece spunyarn 1½ fathoms for siezing the clinch of the fall.

1 Hammer.

4 Hand Spikes.

3 Shoes, with holes in them to receive the spikes of the feet of the Gin, if these are lost or mislaid, handspikes, laid on the ground, one on each side of the spike of each cheek, will answer for this purpose.

One Non-Commissioned Officer and 19 Men are required for the service of a Gin.

DISPOSITIONS AND DUTIES OF MEN.

LEFT SIDE.

3. Carries foot of left cheek, works left handle, keys and unkeys the left cap-squares, runs carriage up or back.
5. Carries top of left cheek, works left handle, runs carriage up or back.
7. Carries cross bars, handspikes, and shackle, and bolt assisted by 14 ; assists 6 to pass fall round the windlass, holds on next to 6.
9. Carries top of pry pole with the slings, shoes, and fid, holds on the fall behind 8 and coils it up.
11. Carries blocks and fall, reeves and unreeves the triple block, assists in slinging the gun and steadies it on his own side.
13. Assists 6 to carry windlass and work left handle.
15. Assists 6 to carry the windlass.
17. Carries upper cylinder.
19. Carries lower cylinder with winch handles.

RIGHT SIDE.

2. Carries foot of right cheek, works right handle, keys and unkeys the ~~left~~ right cap-squares, runs carriage up or back.
4. Carries top of right cheek, works right handle, runs carriage up or back.
6. Carries windlass assisted by 12, 13, 15,—passes fall round it, holds on the fall, and makes it fast, runs carriage up or back.
8. Carries foot of pry pole, with the slings, shoes, and fid, holds on the fall behind 7.
10. Carries blocks and fall, reeves and unreeves double block, assists in slinging the gun, and steadies it on his own side.
12. Assists 6 to carry windlass and work left handle.
14. Assists 7 to carry cross bars, &c. &c.
16. Carries upper cylinder.
18. Carries lower cylinder with winch handles.

The loose articles carried by 8 and 9, are to be secured over the middle of the pry pole, by the lashing rope.

7, 14, lash the handspikes, &c. to cross bar with the spunyarn lashing.

1, carries the hammer.

10, 11, carry the blocks, &c. by means of a handspike passed through the hooks of both blocks, the fall in a long coil placed over the blocks, hanging down equally on both sides.

The gin ought only to be carried when the distance is short; when the distance is long it should be put on a platform cart.

It is perfectly immaterial on which side of the gun, &c. the cheeks of the gin are placed, but for the sake of uniformity they should be placed on the left side of the piece, the right cheek towards the cascable, and in conformity to this, the gin must be laid down when brought up to the piece.

" *Prepare to put the gin together and reeve the tackle,*" at this word 8, 9 unloose slings, shoes and fid, 8 places the slings, fid and lashing rope, close to the blocks, on the right of the gin; 9 lays down the shoes to receive the feet: 6, 12, 13, 15, place the windlass between the cheeks—7, 14 place the shackle and bolt at the head of the gin, and the cross bars on the left of the cheeks, 4, 5, 8, 9, bring the top of gin together, the holes of the cheeks and pry pole in a position to receive the bolt, 5 manages the shackle; whilst this is doing 11 places the triple block on its side in line with and about eight feet distant from the top of the gin, 10 the double block on its side about six feet distant from the other towards the foot of the gin, 11 lays the fall coiled to the left midway between the blocks, the end of it clear for reeving, 10, 11 then stand back to back between the blocks having the hooks outwards; 11 passes the end of the fall between his legs, and through the lower sheave of the triple block, then passes it back between his legs to 10, who in like manner passes it through the lower sheave of the double block, then passes it to 11, to reeve through the middle sheave, 10 passes it through upper sheave, and 11 through his; he then gives the end to 10 who passes it through the loop at the end of the double block, and forms an inside clinch; 11 seizes it with a list of spunyarn, this done, they bring the tackle close to the top of the gin, blocks fleeted so far that the triple one may be hooked to the shackle, and the double one to the cross bar, the running end of the fall to the left.

Whilst this has been doing the word is given " *place the windlass*" 6, 12 puts the gudgeon into the gudgeon hole of right, and 13, 15 of left cheek; 16, 17 put the gudgeons of the upper cylinder, into their holes, and 18, 19 the ends of the lower cylinder through the holes in the cheeks, and fix the handles; 2, 3 keep the cheeks square, and when the gudgeons are in the holes close the cheeks, by placing handspikes under the spikes on the outside, 7, 14 put on and bolt cross bars.

" *Put the gin together.*" 4 holds up right cheek, 9 pry pole, 8 puts the bolt through those and shackle, which 5 holds up, and then quits and places the left cheek on the bolt, 8 pushes it home 9 keys the bolt.

" *Prepare to raise the gin.*" 2, 3 each plant a handspike slantwise under the cross bar close to the cheeks to prevent the gin from slipping, holding the handspikes as running up a gun, 16, 17 fasten the lashing ropes to the foot of pry pole, at which they haul while raising the gin, 4, 5, at the top of the gin, 6, 7, next, then 8, 9, 12, 13, 14, 15 stand ready to raise the gin.

" *Hook the tackle.*" 2, 3 bear against the cross bar, 16, 17 bring the foot of pry pole back towards the cheeks ; 4, 5, 6, 7, 8, 9, 12, 13, 14, 15 lift the top, 11 assisted by 10, hooks the triple block to the shackle, the back of the hook to the pry pole, and the side of the block on which the running end of the fall comes through, is to front the windlass, 10 passes the double block under the gin and hooks it to the cross bar, back of the hook downwards, 10, 11 then place themselves outside of 16, 17.

" *Raise the gin.*" 10, 11, 16, 17, walk backwards hauling the pry pole towards the gin, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15—raise the gin as high as they can do, until the word " *halt.*" If the ground be soft " *prepare to put shoes under the feet*" 3 goes inside the gin and places his handspike under the cross bar opposite 2, they raise the cheek while 4 places the shoe, 2, 3, then move to left cheek, which they lift while 5 places the shoe, 8 places the shoe under the pry pole which is lifted by 16, 17 ; the following words are then given ;

" *Post yourselves ;*" " *Pass the fall round the windlass ;*" " *Put on slings ;*" If the gun be dismounted, 2, 3, 4, 5 run the carriage up close to the breech of the gun, if the gun be mounted, they unkey and take off cap-squares ; they then place themselves at the handles with 12, 13.

8, 9 place themselves outside the windlass fronting the gin, behind 7, ready to receive the fall, after it shall have been passed round the windlass.

Whilst this has been doing, 6 inside of the windlass passes the running end of the fall over the windlass to 7 outside of it, who then passes it to his right under the windlass to 6, who returns to his left over the windlass to 7, who again hands it to 6, and so on until three complete turns have been taken ; after which 7 hands the fall to 8, 9 who stretch it out ; the turns round the windlass are to be close to the iron hoops next the right cheek, 6 comes round outside, and takes hold of the fall, the fall is to pass between 6, 7, 8, 9 who hold on 6, 8 on the right and 7, 9 on the left of it ; they all nearly front the gin and take hold of the fall with both hands, their outer hands in front of their inner ones, their feet advanced in a way corresponding with the hands.

10, 11, take up the sling ; 10 or 11 according to the side passes his end round the neck of the cascable ; the other number twists it to a proper length, holds the bight in front of the bore, and the number who passed the sling round the cascable, puts the fid through it, and into the bore, they then place themselves opposite the trunnions, 10 between the cheeks of the gin and the gun, and 11 on the other side.

" *Hook the block.*" 10 overhauls the tackle, 6 easing the fall off the windlass, 11 takes hold of the part of the slings just above the centre of gravity of the gun, and passes it over the hook of the block which is held for him by 10, the partitions of both blocks are to be perpendicular to the windlass ; if not 10, 11 slew them into their proper position.

" *Shift fall to the right of the windlass.*" 7 seizes the standing part of the fall above the windlass, and hangs on with the weight of his body ; 8, 9 ease off the turns of the fall just so much, that 6 can shift them as directed.

" *Haul taught.*" 6, 8, 9 do this, and 7 resumes his post at the fall.

Every thing having been arranged for working the gin, the word " *work the handles*" is to be given, 2, 3, 4, 5, 12, 13 work the handles, 6, 7, 8, 9 holding on, taking in the fall hand over hand, as it comes off the windlass, 9 coils it with his right hand ; 10, 11 steady the gun.

When the gun has been raised the required height, the word " *make fast the fall*" is given ; the numbers at the handles remain steady, 7, 8, 9 let go the fall to 6, who having fast hold of it, walks up hand over hand, until his right hand comes to be a foot distant from the windlass ; when he will with the same hand pass the fall downwards ; he then with his left hand passes some of the fall over the cross bar, passes his left hand under the bar, and hauls the fall outwards, and then upwards towards himself, keeping fast hold of it with the same hand ; 7 assists 6 to pass plenty of the fall over the cross bar, 6 quits the part of the fall he had hold of with his right hand, and with the same hand passes some of the running part of it, from right to left above the windlass and inside or across the part of the fall which is above the windlass, hauling a good deal of the bight to the left of this part ; he then takes hold of the fall with his right hand, back upwards, and hauls it downwards, keeping it taught, also making use of the left hand for the same purpose ; this will jam it between the windlass and the standing part of the fall ; he then with his right hand, lays the running end or slack part of the fall between the windlass and cross bar ; brings it round inside to the left through the bight and hauls taught ; or in other words he makes a half hitch with it, round all the parts of the fall between the windlass and cross bar. " *Run the carriage up*," 2, 3, 4, 5, 12, 13, 14, 15, run up the carriage, and when properly placed, that is, the trunnion holes directly under the trunnions ; " *halt*" the numbers then return to their places—if the gun is to be dismounted they run the carriage back.

" *Prepare to lower the gun*." 6 takes hold of the left part of the hitch with his left hand, and with his right pushes the bight of the fall out of the hitch ; he then shifts his right hand back uppermost to the portion of the fall to the left of that part of it which is above the windlass, keeping fast hold ; with his left hand he takes hold of the outer part of the fall near the cross-bar, and then with his right hand, throws the loose part of the fall over from his right towards his left, and with the same hand, takes hold of the fall a foot below the windlass, as he had done at first, places his right foot against the cross bar keeping his body a little back the fall being nearly horizontal. 7 stretches the fall to the rear " *lower the gun*," 2, 3, 4, 5, 12, 13, work the handles until the gun is lodged in the carriage, or lowered on the ground, " *unsling the gun, and take off the slings*" 10, 11 take the lashings off the slings, 6 eases off the fall, 10 overhauls the tackle to lower the double block ; 11 lifts the slings out of the hook, and then draws out the fid ; 10 takes the slings off the cascable and hooks block to cross bar. If the gun has been mounted on its carriage, 2, 3 put on cap squares and key them, 2, 3, 4, 5, 13, 14, 15 run the carriage back clear of the gin.

" *Prepare to strike gin.*" 7 outside the gin, and 6 inside, pass the fall to one another till the turns are taken off the windlass; 6 lays it to the right in line with the foot of the pry pole; 2, 3 plant each a handspike under the cross bar, 8, 9 place each a handspike cross ways outside the foot of pry pole, the other numbers except 2, 3 place themselves under the cheeks.

" *Strike the gin.*" 8, 9 force the foot of pry pole forwards, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, walk backwards to the top of the gin as it is lowered, supporting the cheeks and turning themselves by degrees, so as to front the cheeks when lowered, 11 unhooks the upper block from the shackle, and 10 the lower one from the cross bar, place them to the right of the gin and unreeve the tackle.

" *Take the gin to pieces.*" The whole of the numbers undo what they performed in putting the gin together, thus 2, 3 unkey the cross bar, and keep the cheeks horizontal, 9 unkeys shackle bolt; 8 draws out the bolt; 6, 7 separate the cheeks: 4, 5 at the top of the cheeks;

Howitzers are slung as guns.

MORTARS.

When iron mortars are mounted or dismounted either from beds, or mortar carts with a gin, they are slung by their dolphins, but should there be a doubt as to the resistance of the dolphins, (or one be broken off) the hook of the lower block must be placed between the dolphins, and a lashing rope passed through the dolphins, and four or five times over the hook of the tackle and round the mortars by 10 and 11.

Brass, and iron mortars without dolphins are slung by 10, 11 passing a lashing rope four or five times round the chace of the mortar, and hook of the lower block. Steadying the mortar when slung is done by 10, or 11, (according to the side) placing a handspike in the bore.

In mounting or dismounting mortars from their beds, the cap-squares are attended to by the same numbers as in guns.

Placing mortars with beds on mortar carts one 10 or 8 inch, or two 5½ inch mounted on their beds are carried on a

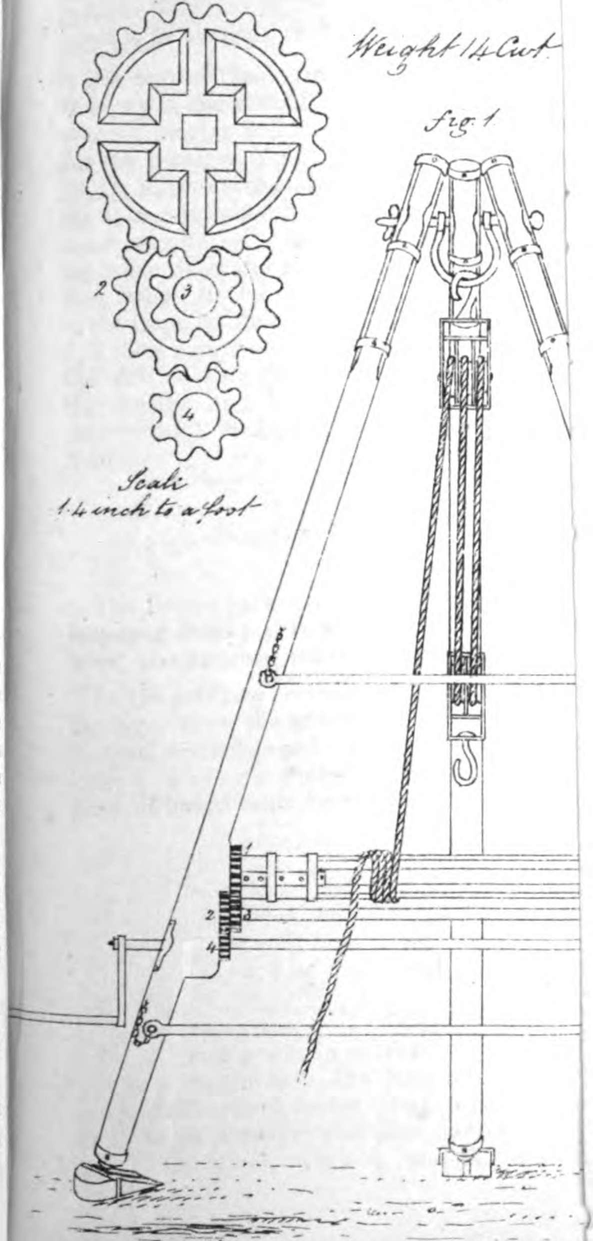
Machines

For Mounting & Dismounting S

Gin

Weight 14 Cwt

Fig. 1



Scale
1.4 inch to a foot

Scale 3½ tenths to a

mortar cart, the muzzles of the heavy mortars are placed towards the front of the cart, the muzzles of the 5½-inch inwards or towards each other.

One part of the bight is placed under the projecting part or horns of the rear of the cheeks, the sling is then brought over the mortar and twisted, and the other bight placed under the traversing parts or horns of the front of the bed, by 10, 11, the mortar and bed are then raised in the same manner as a gun, when high enough, the cart is run under by the same numbers that run the carriage up, and the slings are taken off in the same way ; the mortar and its bed are then lashed to the cart ; 2, 3 lash the front traversing bolts to the front lashing rings ; 4, 5 the rear bolts to rear rings ; 2, 3 then mount on the cart and lash the mortar and bed to the cart, passing the lashing rope, three or four times over the mortar and bed and centre lashing rings, frapping the returns and making fast, which is to be done with all the lashings.

SECTION 3.—LIFTING JACK.

The lifting jack composes part of the equipment of every battering train ; it is applied to the same purpose as the long lever, but requires much less power to put it in motion.

In the artillery service it is used for raising gun or other carriages from the ground, in order that their wheels may be greased or exchanged ; in extricating wheels out of ruts or holes ; when in marshy ground, to prevent its sinking, a piece of board must be placed under it.

There are two kinds in the service.

1st. The tooth and pinion jack.
2d. The screw jack.

The tooth and pinion Jack.

Fig. 2.

Is of great power in extricating a carriage or wheel sunk low in a rut or hole, the jack must be placed close to the nave of the wheel, under which a rope is to be passed, drawn as tight as possible, and then fixed to the forked end of the jack ; the winch worked, and as the wheel rises, stones or other hard substances thrown underneath, to prevent it from sinking again when a fresh purchase is taken. The foot of the jack ought also to be made to rest upon something hard.

The Screw Jack.

Fig. 3.

Is of greater power than the former, and may be called an elevating screw of large dimensions.

The foot of it is furnished with three spikes, to prevent to jack slipping or turning the screw round, which it is apt to do till the weight bears on it : however if a square piece of board pierced with three holes to correspond with the spikes, and in which they are to be inserted, were placed under it, this would be obviated.

The tooth and pinion, and screw jacks, may be applied to moving bodies horizontally a few inches, provided a good abutment or support can be had for the foot of the stock; or in bringing as close as possible two bodies, which are to be spliced or rivetted, by applying them in opposite directions.

SECTION 4.—FULCRUMS AND PROPS.

Fulcrums and Props are pieces of wood of various lengths; any piece of timber will do.

Fulcrums.

Fulcrums are to be placed at such a distance from the body to be raised, that when the lever rests on their tops, the point may be put under the body, and the lever form such an angle with the horizon, that, when it is heaved down, and the small end nearly touches the ground, it may have lifted the required weight.

Props.

There cannot be a better prop than a quoin, when it is long enough, or a piece of wood of that shape, of a proportionate size.

If the wheels of a carriage are to be taken off, and the carriage propped, the trail should be first secured from slipping ; the props, which are placed under each cheek, or the shoulders of the axletree, may have a slight inclination towards the carriage.

But when one wheel only is to be taken off, and the other scotched, the prop may be placed vertically ; however practice alone will point out the proper position of props in all situations.

It must be recollected, that the point of the lever is never to be withdrawn, until it is evident that the prop is well placed.

SECTION 5.—CRAB CAPSTAN.

Fig. 4.

The Crab Capstan is a machine used in the service of Artillery, to raise and lower with few men considerable weights, to get guns, &c. up inclined planes, or precipitous ascents, steep and narrow ramps, and mountainous roads, which may have frequent and short sharp turnings ; stretching and hauling taught the sheer line in pontoon bridges, &c.

In using the crab capstan, it must be fixed by ropes to a post driven in the prolongation of the line, in which the body to be acted upon is to move.

The running end of a single rope or fall, whichever is used, is passed two or three times round the barrel, and this end must always be uppermost, for as the standing end winds, it forces the turns up the barrel and clears itself.

The number of men required must depend upon the application of the capstan, whether to lift weights entirely off the ground, or to haul them up an inclined plane, also on the inclination of that plane.

But six men at the least are required, four of them, viz. 2, 3, 4, 5 for the capstan bars, and two to hold on the fall ; one of whom, 6 eases off when ordered to do so ; the other, 7, coils it up, as it comes off ; 2, 3, 4, 5 drive the post for the capstan, and lash it to it.

The capstan bars are long enough to allow of six men being applied to each ; three at each end.

The gin windlass may be applied to the same purpose as a capstan, by laying the cheeks of it on the ground, and securing them with posts ; the fall of the tackle is passed round the windlass, which is worked in the usual manner; but this is a very slow mode of proceeding, and would only be resorted to when a capstan could not be had.

SECTION 6.—SLEDGES.

Should the Artillery be without devil carriages, or platform carriages, common sledges may be adopted for transporting guns and mortars, as they are easily made; they have been found of essential use in small expeditions, in which recourse has been had to the Navy for the use of their guns, to carry on operations on shore.

If the ground be of a marshy or shingly nature, the under part of the sledge must be covered with planks, to prevent the earth, mud, &c. accumulating in front of the transoms, and when there is time, the under part of the side pieces ought to be shod with iron, to prevent them wearing away.

There is another sledge, called the sally-port or roller sledge, narrower than the other, but of the same shape.

With this sledge and three or four rollers, a gun may be moved quickly along a sally port or passage of only four feet wide, and along one of six feet with a turning at right angles.

The sledge can also be hauled up narrow ramps of fortifications; the roller prevents its damaging them.

The ropes for guiding or steering the sledges are attached to the hind part, and cross each other, so that the men haul upon that which is fixed to the side farthest from them.

Placing a Gun on a Sledge.

It must be skidded or parbuckled up; the ends of the skids next the sledge raised, so as to be flush, or rather higher than the side pieces, sometimes the skids may rest on the side pieces, or pieces of timber, or quoins, &c. must be placed under them.

When the gun is at the upper end of the skids, it should be so placed, that when it is rolled over, it may drop into its proper situation.

The breech should always be at the hind part of the sledge, vent uppermost; 4, 5, or 6 men, according to the nature of the gun, place it on the sledge. The gun is to be lashed to the sledge.

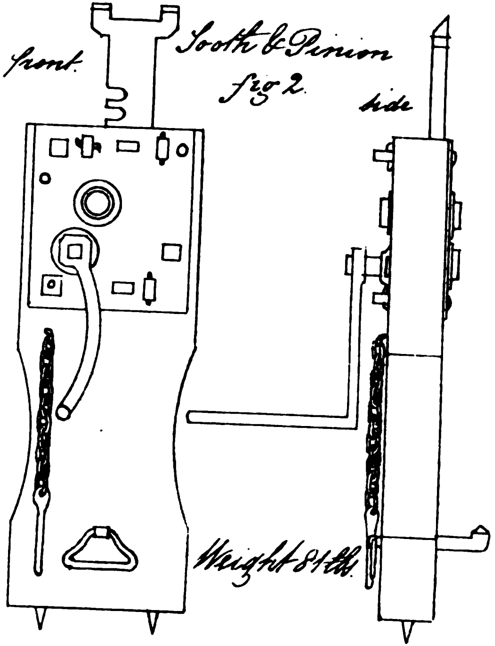
Machines

For Mounting and Dismounting Heavy Ordnance

Jacks

Tooth & Pinion

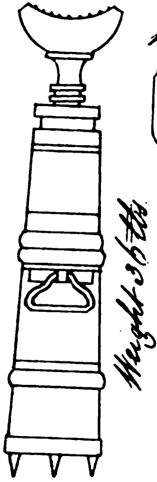
fig 2



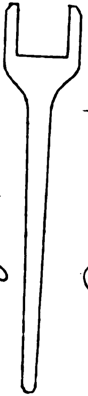
Scale 1 Inch to a Foot

Screw

fig 3

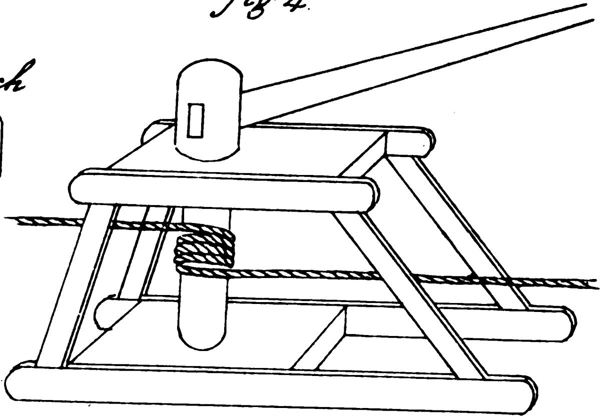


Wrench



Crab Capstan

fig 4



Scale ·4 of an Inch to a Foot.

Pinching a Gun off a Sledge.

This is performed by placing handspikes under the breech and muzzle, to raise the gun, and roll it off, assisted by a rope fastened to one of the trunnions and hauled upon.

The following are the articles with sledges.

Drag ropes or men's harness. } *according to the nature of the Gun.*

Eight lashing ropes, about 12 *feet long, each with an eye splice,* 4, 5, *or* 6 *handspikes.*

Two skids.

Two small pieces of timber, or a couple of quoins.

A dismounted gun can be moved along by placing trucks on the trunnions; but attention must be paid that they do not slip off, which they are apt to do.

SECTION 7.—ROLLERS.

Are of great service in the Artillery, by their means guns can be mounted on their carriages, can be shifted from one carriage to another, and can be moved through sally ports, and narrow passages, where no carriage could pass, more especially should there be a turning in them.

Rollers for moving guns through sally-ports are generally of the following dimensions, and are pierced with two holes at each end, which cross each other at right angles, for the points of levers; 5 feet, 4 feet, and 3 feet in length: 8 inches in diameter.

For mounting guns, and shifting them from one carriage to another, they are smaller; the dimensions of which are stated in page 21.

Where rollers are moved by levers, it is essential that the surface of the ground over which they are to pass be uniform, and clear of obstacles.

In moving cylindrical bodies on rollers, the latter should be perfectly horizontal, as the gun, &c., might roll off.

The rollers are to be placed at right angles to the piece, projecting equally on each side; if there be space, the gun may be steadied as in page 3, a strap may be put under each trunnion, and a handspike thrust through both bights.

If the passage be very narrow, a piece of 1 inch plank, the same length as the gun, with a hole at each end to lash it to the piece, may be placed under each trunnion, to prevent the gun from turning.

With few men, tackles, or capstans may be used for moving the gun, instead of levers for rollers, and in crooked passages pickets may be driven at the turnings, and leading blocks hooked to them, which will keep the running end of the fall in the proper direction; or, dragropes may be attached to the cascable, or muzzle; they must be hauled very steadily or the gun would slip off.

The number of men required must depend on the nature of the gun, and the ground over which it is to pass, whether up ramps, or slopes, &c. Four men are at the levers; two steady the gun; two shift the rollers; two with the handspikes; when levers are not used, the men who are posted to them, will mann the muzzle or breech rope.

SECTION 8.—KNOTS.

Thumb or overhand knot, 1, 2, to tie the end of a rope to prevent it from opening out.

Right or reef knot, 3, 4.

Draw knot, 5, offers great facility in undoing a knot.

Running knot, 6, used to bind or draw anything close.

Sheepshank, 7, 8; serves to shorten a rope without cutting it.

Clove hitch, 9, 10, 11, 12, 13.

Timber hitch, 14.

Single bowline knot, 15; serves to throw over a post or timber head to haul on; also to sling a barrel, 37.

Double bowline knot, 16; for slinging a cask.

Woolding or packing stitch hitch, 18, 19; for tightening a rope.

Running bowline knot, 17.

Men's harness hitch, 20, 21, 22.

Stopper hitch, 23, for stoppering the fall of a tackle, &c.

Inside Clinch, 24 ; for fastening the cable to the ring, of the ring of the anchor ; and also the standing end of the gin fall to the lower block, which however only requires one seizing.

Outside clinch, 25.

Common or sheet bend, 26, 27 ; sometimes in making it, an additional turn is taken as in 28.

Hawser bend, 29.

Cats paw, 30, 31, 32, 33 ; is a name given to a particular turn made in the bight of a rope, in order to hook a tackle on it.

Drag rope or lever hitch, 34, 35 ; the same as the men's harness hitch, and used for fixing handspikes, 36, to the ropes attached to heavy carriages, which are to be moved by men ; three men to each handspike.

Slinging a barrel with a single bowline knot, 37.

Double sling for a barrel 38.

Slinging a cask standing on its end, 39, 40.

MOUNTING AND DISMOUNTING ORDNANCE WITHOUT A GIN.

Various methods of performing the same operation have been detailed, with the view of making the men more expert in the exercises, and familiarizing them with the use of the handspike, leaving the mode most applicable to circumstances, and the means which may be at hand, to be put in practice by those charged with the execution of the manœuvre on service.

SECTION I.—IMPLEMENTS REQUIRED FOR THE MANŒUVRES.

The following implements will be required for the various operations, though only a few of them for particular manœuvres.

Handspikes, 8 or 10, some of which ought to be bevelled.

Levers, 8, 10, 12, and 14 feet in length.

Fulcrums, any piece of wood may serves as a fulcrum; the best dimensions for general purposes are 2 feet long, 1 foot broad and 7 inches thick; handspikes are often used as fulcrums.

Skids, for mounting and dismounting guns by parbuckle, should be about 14 feet long, and 7 inches square; two 3-inch planks, or three 2½-inch, bolted together, will answer; their ends should be bevelled.

Parbuckling a gun from the terreplein on to the parapet, or, on to its carriage on a traversing platform, at one operation, requires skids of 20 feet long, and 8 or 9 inches square.

To parbuckle on a platform waggon, the waggon serving as an inclined plane, requires 2 pieces of scantling each 10 feet long, and 4 inches square, or 4 pieces of 2½ inch plank of the same length, and 5 inches wide, to strengthen the side pieces of the waggon.

Skids for mortars and their beds should be 12 feet in length, and 8 inches square for the 13 inch mortar; 6 inches by 7 for the 10 inch, and 6 inches square for the 8 inch.

These skids are kept together by iron bolts of 1 inch in diameter with shoulders and keys, so that when in use they are nearly at the following distances from each other.

13 Inch mortar	3¼	inches.
13 do. do. bed	11	do.
10 do. do. and bed	3½	do.
8 do. do. do.	2½	do.

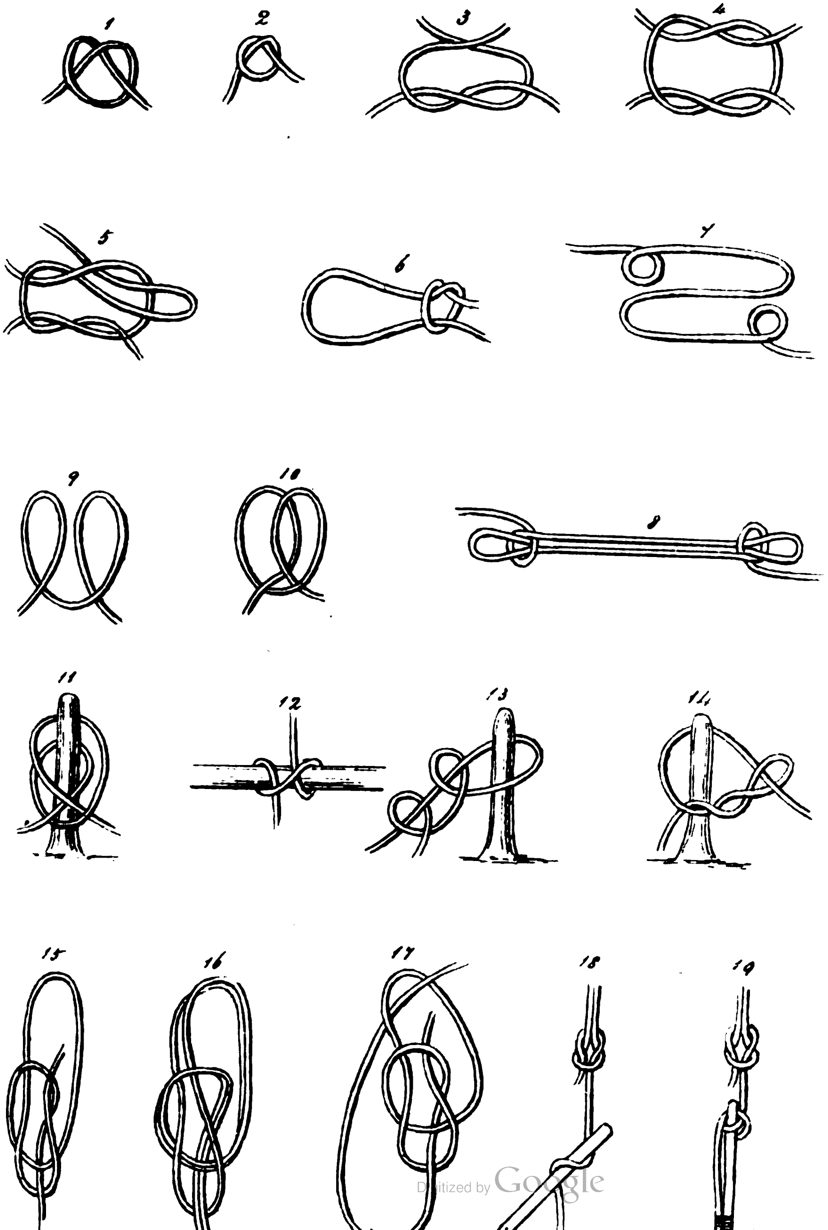
Skids may be applied as levers.

Skids (short) for placing across the cheeks of Gun carriages, or side pieces of platform waggons, should be from 2 feet 8 inches to 3 feet long, and of various scantlings, from 9 inches by 6, to 4 inches and 3 inches square, a handspike may be applied to this purpose.

Machines

For Mounting & Dismounting Heavy Ordnance

Knots.



Machines

For Mounting & Dismounting Heavy Ordnance.

Knots.

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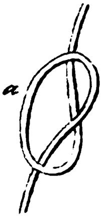

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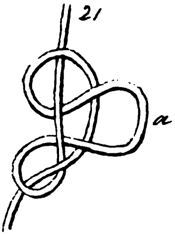

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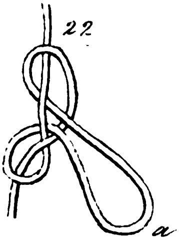

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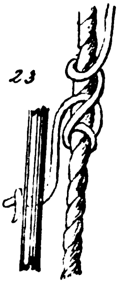

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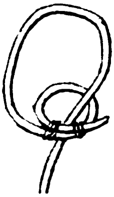

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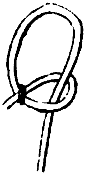

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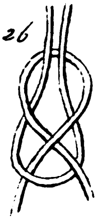

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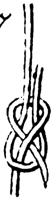

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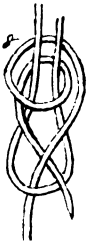

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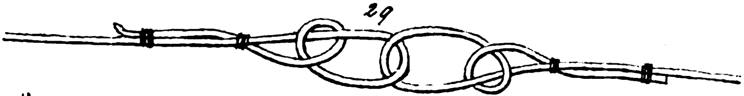

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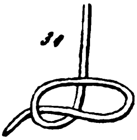

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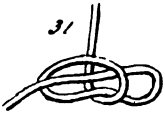

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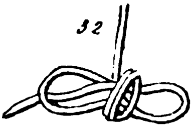

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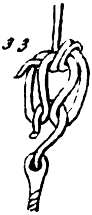

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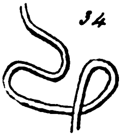

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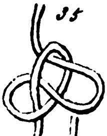

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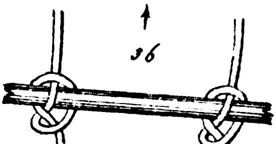

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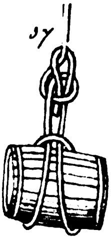

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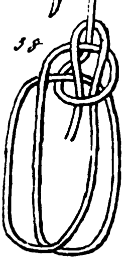

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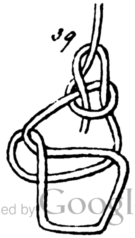

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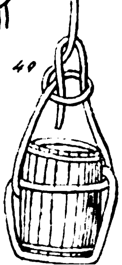

Pieces of skidding—from 4 to 7 feet long, and from 6 to 8 inches square.

Props, may be of any scantling, but not under 5 inches square, and from 2½ to 3½ feet long.

Rollers, ought to be in sets of three.

1st set	3 to 4	feet long		7½ inches diameter.
2d ,,	3	do.		
3d ,,	2½	do.	do.	5 inches diameter.
4th ,,	2	do.	do.	
5th ,,	20	inches	do.	
6th ,,	14	do.	do.	

They ought to be concave or hollowed out a little in the middle, to about the depth of a quarter of an inch.

Planks, for shifting guns from one carriage to another, should be of 3 inch deal about 10 feet long; the general width of 11 inches will do; when for shifting a gun from the parapet to a traversing platform, they out to be 2½ inch oak plank, and about 12 or 14 feet long.

Quoins, 2, 3, or 4 common ones.

Wedges or Scotches, or Chocks, for chocking or scotching wheels, or guns on skids, about 9 inches long, 5 inches broad, and 4 inches at the butt end; others of 12 or 15 inches long, 5 inches broad, and 3, 2 and 1 inch at the butt end; but any thing will answer for checking wheels, a stone, a handspike, a quoin, &c.

Park pickets, 4 or 6.

Mauls—2.

Parbuckles, 4 inch rope, 12 fathoms long, with a hook at one end, and a loop at the other.

Lashings.	single	1	fathom	long of 2 inch rope.
	double	2	do.	
	triple	3	do.	

Dragropes, a rope for that purpose, from 22 to 30 feet long, with a hook at one end, and a thimble, or loop, at the other.

Lufftackles, blocks 8 inch; the falls each 12 fathoms of 2½ inch rope: instead of a tackle a piece of common rope will do, but then more men will be required for the operation; besides, the action with the rope will be often irregular and violent, and can never be so uniform and gentle as with a tackle.

Straps, of various dimensions, some of 3½ inch rope, and 8 feet long, for mounting mortar beds, some for slewing and also for steadying ; a piece of common rope will however answer equally well, and indeed is better.

Boxes and blocks of elm, for mounting and dismounting guns ; a set consists of two boxes or blocks of each size. See Section 16.

SECTION 2.—GENERAL DUTIES OF THE MEN.

In all manœuvres, according to the number of handspikes employed, 2, 3, 4, 5 have charge of the muzzle ones ; 8, 9 those at the trunnions, and 12, 13, 14 and 15 those at the breech ; 6, 7 have charge of the rollers and short skids which are laid across the cheeks of the carriage, and place and remove them as required ; in general 6 the muzzle roller and 7 the breech one and also the gun roller ; they chock or scotch the wheels ; 6 manages and arranges the quoin, and 7 the semelle and elevating screw, and assist each other ; 8, 9 steady the gun by means of straps and handspikes, and slew it when required ; in parbuckling, 8, assisted by 10, places, the front skid, and 9 assisted by 11, the rear one ; when the skids are to be bolted together, they do it ; assisted by the nearest numbers.

10 fixes a dragrope on the muzzle, and 11 one on the cascable ; 12, 13 fix the parbuckles, and 6, 7 arrange them round the gun and attend to them ; with luff tackles, 6, 7, 12, 13 reeve them ; 12, 13 hook or fix the single blocks and 6, 7 the double ones.

When not required for any preparatory steps about the gun, 12, 13, drive the pickets ; but when so engaged they are to be driven by 10, 11, unless there be more than 12 men for the operation, when some of the spare men are to be employed for this purpose ; 2, 3 take off and put on the capsquares.

When the wheels are to be taken off, 8, 9 take out and replace the linch pins and washers.

When one lever and one fulcrum are used, 6, or 7, according to the side, places the fulcrum, and 2, 4, or 3, 5, the lever.

If two levers and 2 fulcrums be employed, 6, 7 place the fulcrums ; and the levers, each on their respective sides, are placed by 2, 4, and 3, 5.

If a lever is applied to the bore, it is to be put in by 2, 3.

When the gun is moved on rollers, from one carriage to another, 2, 3, 4, 5 under the chase or under the swell of the muzzle, and, 12, 13, 14, 15, under the breech or under the first reinforce, will, when necessary, apply their handspikes as for cross lifting, and act so as to make the gun move along, by pinching it, or rowing it.

When a gun is to be skided along to the parbuckling skids, 8, 10, and 9, 11 shift the skids, placing others as the gun is about quitting those on which it may be; all the men not employed at the handspikes, or in shifting and placing rollers, &c. are to be posted to the parbuckles or dragropes, as the case may be, or assist the men at the muzzle when it is to be lifted or borne down.

The men charged with the handspikes and rollers should be the most intelligent of the party.

The whole of the arrangements are made by twelve men, being the number for a 12-pounder, all above that number are for pulling and hauling.

Though the foregoing are the general duties of the men whose numbers have been specified, yet, according to circumstances, there are various others, which in the course of a manœuvre they may be called upon to perform, and which cannot be foreseen: arising perhaps from the awkward position of the gun, or of the carriage; from a sudden shift of the gun from one side to the other, from the ground giving way; from a handspike breaking, &c. &c.

The object aimed at, is, that, as far as possible, the same numbers should always execute the same thing; for example, it will be perceived that 6, 7, have a great deal more to do than many of the other numbers; and, that, in some manœuvres it might have been as well to have assigned some of these duties to others, but it was thought advisable to throw the same duties always on the same men, as it tends to simplify the exercise and make it more easy to remember. In fact, when the men are expert, they will all be doing something towards the execution of an operation, though not assigned to them as a particular duty.

General rules only can be given for the performance of the following manœuvres; the details and the words of Command must depend on circumstances and situation.

It is impossible to indicate the exact spot where the point of a handspike is to be applied, or a roller, or a piece of skidding placed; or how much the gun is to be raised or to be moved at one time or heave; an inch too much or too little either one way or the other, may cause delay, and render an operation tedious and difficult.

According to the situation of the gun with respect to the carriage, so will the order, or side, vary, on which the numbers are drawn up.

Whenever a gun is to be moved on its carriage, or from one carriage to another, in the direction of the axis, the men are to be drawn up in the usual way, the even numbers on the near side, and the odd numbers on the off side. When the gun is limbered up, they look towards the trail, or the limber, or direction the gun is supposed to be moved in. When unlimbered, they look towards the muzzle or direction to which the gun points ; 2, 3, being in all cases next to the muzzle.

In parbuckling a gun on to its carriage, and when the skids are placed perpendicular to the cheeks or to the side, the even numbers will always be on the side on which the muzzle of the gun is, and the odd numbers on the side of the breech ; and in pinching the gun up on the skids and using the handspikes, 2, 3 will have the muzzle ones and 4, 5 the breech ones.

The number of men required for a

	N. C. Officers.	*Men.*
24-Pounder Gun............	1	18
18 „ „	1	14
12 „ „	1	12
10-Inch Howitzer...........	1	18
8 „ „	1	12
13 „ Mortar	1	14
10 „ „	1	8
8 „ „	1	4

They are to be numbered as usual, and placed on each side of the piece or carriage, at two feet distant from the outside of the wheels, and two paces distant one from the other.

The manœuvres are supposed to be performed with a 24-pounder, unless when stated to the contrary ; and when for inferior calibres, the numbers are reduced, the duties assigned to 14, 15 may be performed by 10, 11 ; and when only 11 men are required for the operation, those assigned to 12, 13, may, if necessary, be performed by 8, 9 ; any disposable numbers steadying the gun ; as, for example, 6, 7 ; 1 placing and withdrawing the rollers, but the lighter the calibre, the fewer handspikes will be required, and if necessary, two or all of the muzzle handspike men will shift to, and assist at the breech, and the breech handspike men shift to, and assist at the muzzle.*

SECTION 3.—TO RAISE A GUN OUT OF THE TRUNNION HOLES PREPARATORY TO DISMOUNTING.

One Non-commissioned officer and eighteen men.
One 14 inch roller, or the Gun roller.
Eight or ten handspikes.

Two short skids, one 6 inches, and the other 4 or 5 inches square; but if the gun is to be raised very high, *an 8 or 9-inch skid* will be required.

The height to which the gun is to be raised, depends on the subsequent operation to be performed, viz. whether it is to be shifted from one carriage to another, or to be dismounted by parbuckle.

Prepare to raise the gun, 2, 3 remove the capsquares; 2 places a handspike in the bore, and 3 one over it, the point projecting out of the bore about 6 inches, double manned by 3, 8, 9; 5 places one over and across, close to the muzzle, double manned by 4, 10, 11; the whole of them looking towards the gun; 12, 13, 14, 15 place their handspikes under the breech of the gun; 7 works the elevating screw to bring the semelle nearly horizontal.

Bear down, the whole bear down, and a fourteen inch roller, or the gun roller if the gun is on a siege carriage, is placed by 7 under the reinforce, as near the centre of gravity as possible, or a skid laid across the cheeks of the carriage, as the case may be.

Ease off, the gun is allowed to rest on the roller, or on the skid, 5 shifts his handspike underneath the one which is in the bore; 12, if necessary, places a handspike across and under the neck of the piece, double manned by 13, 14, 15.

Lift, the whole lift, and a quoin is placed by 6, 7 on the breast transom under the gun, or the point of a handspike placed in each of the trunnion holes, for the trunnions to rest on; this, however, must depend on the height the men have been able to lift the gun.

Lower, the gun is allowed to descend on whatever has been placed to receive it; the operation, if necessary, is to be repeated.

This must always be the case if the gun is to be parbuckled off its carriage, in order that it may be raised sufficiently high to admit of pieces of short skidding being placed under the first reinforce, and chase, across the cheeks of the carriage; in this position the gun is to be kept steady by wedges placed on the skids by 6, 7, or by 12, 13, with the points of their handspikes.

With a garrison carriage, instead of a skid, the stool-bed may be placed across the carriage on the upper steps for the breech of the gun to rest on.

The mode of lowering a gun which is resting on rollers or skids, into its carriage, is exactly the converse of the preceding, the same operations of bearing down, removing the rollers, &c. and allowing the muzzle to rise are to be performed; the gun must be lowered gradually, and great care is to be taken to avoid sudden jerks.

SECTION 4.—WHEN A GUN ON THE GROUND HAS TO BE PLACED ON SKIDS.

With	a lever	6	Men and a Non-Commissioned Officer.
	handspikes	10	
	a travelling carriage	12	

1 *Lever.*
1 *Fulcrum.*
5 *or* 6 *handspikes; if no lever,* 8 *handspikes.*
2 *short skids.*

With a travelling carriage, 3 *fathoms of* 3½ *inch rope.*

Prepare to raise the Muzzle,—6, 7 place a fulcrum exactly in front of the muzzle, and at the proper distance; 2, 3 put a lever over it with the point thrust into the bore.

Bear down—2, 3, 4, 5 bear down, until a handspike or small piece of skidding can be placed under the gun by 6, 7.

The fulcrum is then to be shifted, and a fresh purchase taken, until the muzzle be raised sufficiently high to admit of a piece of skidding being shoved under the gun, near the trunnions.

The breech of the gun is then to be raised in a similar manner; the lever being first applied under the button, and then under the base ring, the skid being placed near the first reinforce ring.

Should there not be a lever, a handspike may be placed in the bore, and the muzzle raised, by applying others on each side across and underneath it; the breech is raised by applying handspikes under the button, and the neck of the cascable, and then under the vent field.

The gun is lowered on the ground, by the converse mode of the preceding.

To raise the breech of a gun by means of a travelling carriage.

Fix the cascable rope,—the carriage is to be in rear of the gun; 6 passes the end of the rope through the breeching loop to 7, they then make an overhand knot on the underside of the neck of the cascable, and bring up the ends.

Run the carriage forward,—the carriage is then run forward by the first eight numbers, until the breast transom be over the button, the axis of the gun and carriage in prolongation of each other.

Scotch the wheels.

Lift the trail,—the trail is lifted by all the men, and 1 places the point of one, or of two handspikes, under the centre transom to support it, the small ends resting on the ground and sloping towards the rear; 6, 7 bring the ends of the rope up in front of, and over each cheek, take a half hitch round the capsquare bolts, and then pass them through the trunnion holes to 8, 9, who pass them behind and under the axletree to 6, 7, who, assisted by 8, 9, take one or more turns, hauling well taught, and make fast by two half hitches outside of the cheeks.

Lower the trail,—the handspikes are withdrawn by 1, and the trail is allowed to come gently to the ground, which will raise the breech of the gun sufficiently for a skid to be placed under the centre of gravity.

The trail is again raised and the gun allowed to rest on the skid, the rope is disengaged, the trail lowered on the ground and the wheels unscotched.

If the ground be very soft, pieces of plank should be placed under the wheels.

When it is necessary to raise the breech of a gun very high, it may be done on the principle of the transport carriage, and the full complement of men will be necessary; a pair of dragropes or guyropes will be required.

The cascable is to be made fast to the carriage as directed by the foregoing method.

10, 11 make fast the guyropes to the trail transom, one of them is led over between the cheeks to the front, and with the exception of 6, 7, manned by the numbers as far as 10; the rear guy is manned by the remaining numbers.

Lift the trail.—The numbers who lift the trail, will, in succession, fall back to their guy; the men at the front guy haul on it; the trail is raised nearly perpendicular; the cascable rope is hauled taught and made fast by 6, 7 assisted by 8, 9, as before; the trail is then lowered, a skid or skids, placed under the gun; the trail is raised a little, and the cascable rope disengaged.

SECTION 5.—TO CHANGE THE WHEEL OF A TRAVELLING CARRIAGE WHICH HAS A GUN MOUNTED ON IT.

1st.—*The trail serving as a lever.*

One Non-Commissioned Officer and five men.

Prepare to change the off-wheel—4, 5, 6 bring up the new wheel, and place it on the ground near the off-wheel. If the gun be limbered up, 2 unkeys the limber and 3 the draft chain; 4 scotches the near wheel; 5 removes the linch pin and washer; 2, 3, 4, 5 stand to the trail; 6 places two handspikes close together on the ground, and then two more above them, immediately under, and in the direction of the off-cheek; the points being flush with the front part of the axletree.

Unlimber—the trail is raised; 6, 1 place a quoin vertically on the handspikes, the thick end downwards, the thin end crossing the under side of the cheek at right angles to it, and about four or five inches in rear of the axletree.

Lower the trail—the trail is borne down gently, till the cheek bears on the quoin which is to be kept upright by 6, this will raise the off wheel from the ground: 2, 3 keep the trail steady, whilst 4, 5, 6, 1 remove the wheel, and re-place it by a fresh one.

Raise the trail—the trail is raised again, and the wheel touches the ground; 6 removes the quoin and handspikes; and 5 re-places the washer and linch pin.

Lower the trail—the trail is lowered, and the gun limbered up; 2 keys it, and 3 hooks the draft chain; 4 unscotches the near wheel.

Instead of handspikes, a block of wood, or two quoins placed lengthways, one over the other, for the vertical quoin to rest on, will answer equally well.

The above is an easy and expeditious way of taking off the wheel of a heavy gun to grease it.

2d—*When a lever and fulcrum are used.*

One Non-Commissioned and nine men, who, according to the side on which the wheel is, are to be numbered all even, or all odd.

Prepare to change the off wheel—11, 13, 15 bring up the fresh wheel; 7 scotches the near wheel; 9 removes the linch pin and washer; 3 takes up the lever, 5 places its point on the upper surface of the cheek of the carriage.

Place the fulcrum—7 places the fulcrum a little in front of the shoulder of the axeltree, or of the cheek of the carriage, as may be directed.

Place the lever—5 places the point under the axletree, or under the cheek, the small end being raised; it is to be manned by all the men.

Bear down—they bear down the lever, until the wheel is off the ground, which is immediately to be removed by 11, 13, 15, and another wheel put on; 9 re-places the washer and linch pin.

Ease off—the lever is allowed to rise gently, and when free, is removed together with the fulcrum.

Were the near wheel to be changed, 10, 12, 14 would do it; 8 would remove the washer and linch pin; 6 places the fulcrum.

Should the fulcrum be too long to allow of the lever being applied under the axletree, it may be placed before the cheek of the carriage, and the purchase taken under it.

Should the fulcrum be too short, the point of a handspike or a small piece of wood may be placed on the top of it, in order to heighten it.

When two levers are employed, one Non-commissioned officer and eighteen men are required, whose duties on their respective sides are precisely as above detailed; but in this case it will be necessary to drive pickets at the trail of the carriage, on which the trail transom is to bear, and so prevent the carriage from slipping to the rear which it otherwise might do. See Section 6.

SECTION 6.—TO DISMOUNT AND MOUNT A TRAVELLING CARRIAGE WITH OR WITHOUT A GUN ON IT.

1*st—With a gun mounted on it.*

One Non-commissioned officer and eighteen men.

2 *levers, each* 13 *or* 14 *feet.*

2 *or* 4 *fulcrums.*

6 *or* 8 *pieces of short skidding.*

3 *pickets.*

1 *mallet.*

Prepare to dismount the carriage—2, 3, 4, 5 unkey the capsquares and take up the levers; 6, 7 the fulcrums, and place them in front of the shoulders of the axletree or breast of the carriage, according to circumstances; 8, 9 remove the linch pins and washers; 12, 13 drive two pickets in the rear of and touching the hind transom, and another between the cheeks touching the front of the transom, this prevents the carriage from slipping either to the front or rear; 16, 17, 18, 19, come round to the levers, and 12, 13, 14, 15, if necessary.

Place the levers,—the levers are placed over the fulcrums, and under the proper part of the carriage.

Bear down—the levers are borne down until the wheels are off the ground.

Remove the wheels—10, 12, 14; 11, 13, 15 take off the wheels, lay them on the ground butt end of nave uppermost, and shove them so far under the axletree, that the pieces of skidding which are to be placed on the nave may be under and close to the shoulder of the axletree.

Place the skids—8, 9, 10, 11 place them.

Ease off—the lever is allowed to rise until the axletree bears on the skids.

Shift the fulcrums—the carriage must now be lowered by degrees, and the skids, or whatever is placed between the wheel and axletree withdrawn at the discretion of No. 1, who will regulate the placing of the fulcrums; and the working of the levers by giving the words *shift the fulcrums, place the levers, bear down, ease off*, till the axletree rests on the naves. The wheels are then drawn out, until the felloes be under the shoulder of the axletree arm, and pieces of skidding placed on them: the operation of lowering the carriage is then continued, the skids withdrawn, and the axletree allowed to rest on the felloes; lastly, the wheel is drawn out entirely, and the axletree rests on the ground.

When only one lever is employed, it is shifted alternately from one shoulder of the axletree to the other, and one wheel taken off at a time; the skids being properly placed on it, and great care taken not to raise or lower the carriage too much at once; in this case, one Non-commissioned officer and nine men will be sufficient.

In mounting a carriage with a gun on it, the duties are the same as detailed for dismounting.

2d.—*When there is no gun on the carriage.*

If levers be employed 2, 3, 4, 5 will be sufficient to work them; 6, 7 place the fulcrums.

If handspikes only be used, at the word, *prepare to dismount the carriage*—8, 9 remove the linch pins and washers; 2, 3, 4, 5, each passes the end of a handspike under the axletree to 6, 7, 8, 9.

Lift—they lift, and the wheels are raised from the ground, and drawn half off by 10, 12, 14, 11, 13, 15; 10, 11 place each a handspike, or two quoins or pieces of wood, immediately under the shoulder of the axletree.

Lift—the carriage is again lifted, and the wheels entirely removed.

Lower—the carriage is lowered gently on the handspikes or quoins.

2, 3, 4, 5 withdraw their handspikes ; 2, 3 apply theirs under the axletree, and 10, 11 withdraw the quoins and handspikes, which had been laid on the ground to receive the carriage.

The carriage is mounted by the converse mode.

SECTION 7.—TO DISMOUNT A GUN BREECH FOREMOST OVER THE TRAIL OF A TRAVELLING CARRIAGE, AND ALSO TO MOUNT IT.

One Non-commissioned officer and eighteen men.

1*st*—*To dismount the gun.*

2 *pieces of* 3 *inch rope, each six fathoms, or* 2 *parbuckles.*

3 *rollers : one of them of the largest size, the other two* 5 *inches in diameter, and* 3 *feet long.*

2 *dragropes.*

8 *or* 10 *handspikes.*

The carriage is to be unlimbered, and the gun raised out of the trunnion holes as in Section 3 ; 7 raises the semelle, and places the roller on it, and under the gun in the position for shifting from the firing to the travelling trunnion holes ; the trunnions resting on the point of a handspike placed in each trunnion hole.

Prepare to dismount the gun—12, 13 each takes the end of a rope or a parbuckle, they pass them from the outside under the front horizontal spoke of each wheel to 6, 7, who bring them up inside and lay them across the top of the gun; each carrying the opposite parbuckle behind and under the trunnion on his own side, and passing the hook through the rope ; or if there be no hook, securing the end of each rope to its standing part by two half hitches ; 12, 13 then haul tight the parbuckles, take two turns with them round the outside of the naves of the wheels, passing the ropes from the front, under, and then up the rear of the naves, bringing them over to the front ; they place their outward feet against the nave of the wheel, ready to ease off when directed to do so.

Fix steadying handspikes—8, 9 do this, and in this case will require two single lashings, but if the gun has a breeching loop, the gun may be steadied by putting a handspike through it.

Bear down the muzzle—2, 3, 4, 5, 14, 17, 18, 19, bear down the muzzle, and 7, lowers the semelle, that it may not be in the way as the gun descends.

Raise the muzzle and lower the gun—the muzzle men lift a very little, and the parbuckles are eased off gently, so as to allow the gun to descend gradually; care being taken to keep it in the direction of the middle line of the carriage; 6, 7 shift and place the rollers according to circumstances.

When the rollers require shifting, the word is given *hold on,* followed by *raise the breech or the muzzle*, as may appear most eligible to 1;—2, 3, 4, 5, 14, 15, apply their handspikes accordingly, and the operation is continued until the breech of the gun nearly touches the ground; a large roller is placed by 6, 7 behind the trail, to receive the breech, and carry it to the rear; if the roller has been properly placed, it will, when the breech is allowed to bear on the ground, have arrived at the centre of gravity of the gun, so as balance it, and thus the muzzle be elevated and clear of the trail transom.

Should the ground not be firm, two handspikes are to be laid on it in prolongation of the cheeks, and the roller placed on them.

Should the muzzle be likely to strike the trail transom; 1 orders a roller to be placed on the cheeks above it; or the muzzle may be lifted, and the carriage run forward; a dragrope fixed by 11 to the cascable, and manned by 12, 13, 14, 15, 16, 17, 18, 19 will assist in hauling the gun to the rear.

2d—*Mount the gun.*

2 luff tackles complete.

2 single lashings or 2 straps.

1 large strap, or 1 parbuckle or similar piece of rope.

4 rollers, 3 of them, 36 inch; handspikes, dragropes and scotches as before.

The tackles are roved by 6, 7, 12, 13.

Raise the muzzle—the muzzle is raised by 2, 3, 4, 5;—6, 7 place the largest roller under the gun just behind the trunnions.

Run the carriage back—2, 3, 4, 5, 6, 7, 8, 9 back the carriage, so that the trail of it be as far as possible under the gun.

Prepare to mount the gun— if the gun has a breeching loop, 8, 9 pass a handspike through it, and 6, 7 take a turn with the large strap, or parbuckle forward into a strap, round the neck of the cascable, between the handspike and the breech taking one turn on each side, over and round the handspike, and bring the ends towards the muzzle, and hook the double blocks to them ; 12, 13 each makes fast, or lays a strap or lashing round the breast transom, bringing the ends in front of and to the outside of each cheek, and hook the single blocks to these straps.

If there be no breeching loop, 8, 9 fix the steadying handspikes as usual ; 6, 7 place a 36 inch roller across the cheeks of the carriage above the trail transom, and under the neck of the piece.

Man the tackles—the tackles are manned by all the men except 8, 9.

Haul away—the men act accordingly, and the gun is made to mount, shifting the rollers as may be necessary ; a gun roller is placed near the end of the semelle, to receive the gun about the neck astragal ; it is then hauled into its place.

The inclined plane may be lowered, by digging trenches for the wheels, so that the naves may bear on the ground, and instead of luff tackles, the gun may be hauled up by dragropes fixed round the neck of the piece ; the trenches should have ramps, in order that the carriage may more easily be drawn out by them.

Section 8.—TO DISMOUNT A GUN BREECH FOREMOST DOWN THE TRAIL OF A GARRISON CARRIAGE, AND ALSO TO MOUNT IT.

One Non-commissioned officer and eighteen men.

2 *parbuckles, or pieces of* 3 *inch rope, each* 6 *fathoms.*

1 *of the largest sized rollers.*

2 *fourteen inch rollers.*

2 *drag ropes.*
10 *handspikes.*
1 *eight feet lever.*
1 *three inch plank* 8½ *feet long.*
2 *wedges.*
1 *small piece of thick skidding.*

The operation is nearly the same as that detailed for the travelling carriage. Section 7.

Prepare to dismount the gun—2, 3, 4, 5, place a lever in the bore.

Bear down—7 assisted by 6, places the semelle across the upper step of the carriage.

Ease off—the gun is allowed to descend on the stool bed, 6, 7 choke it.

Lift the muzzle—12, 13, 14, 15, 16, 17, and all this disposable men left the muzzle; and 6, 7 each places the point of a handspike in the trunnion holes.

Lower—the gun is lowered, and the trunnions rest on the handspikes.

Fix the preventer ropes—6, 7 fix the preventer ropes to the trunnions, as directed in Section 7, passing the ends down the front of the carriage, and under the fore axletree inside of the cheeks, and bring them out to the rear, outside of the cheeks, where 12, 13 receive them.

Bear down the muzzle—place the plank—the men bear down the muzzle; 7 withdraws the semelle; 8, 9 place the plank, one end resting on the breast transom, and the other end on a small piece of skidding, behind the trail; the semelle, and perhaps the quoin, may also be required under the part of the plank which is over the rear axletree, in order to increase the bearing; 6, 7 place the large roller just in rear of the plank, and then a 14 inch roller in front of the first reinforce ring; 8, 9 fix the steadying handspikes, or pass a handspike through the breech loop.

Ease off the muzzle—the muzzle is eased off, and the gun rests on the roller; 2, 3, 4, 5, take up their handspikes.

Heave and lower the gun—the handspike men heave and pinch the gun to the rear; the men at the lever keep it in a proper direction; 12, 13 ease off the trunnion ropes; and thus they proceed until the gun reaches the ground as detailed in Section 7.

To mount the gun.

8 *handspikes.*
2 *luff tackles complete.*
1 *double lashing, or* 1 *stout strap for ditto.*
1 *large strap, or a parbuckle, or similar piece of rope.*
1 *large roller,* 3 *feet long,* 8 *inches diameter.*
2 *fourteen inch rollers.*
1 *plank.*
2 *wedges.*
1 *piece of thick skidding.*

Raise the muzzle—the muzzle is raised, and the large roller placed under the gun, as directed in Section 7 ; the carriage is then run back under the muzzle by the first eight numbers.

Prepare to mount the gun—the arrangement for the breech is exactly as detailed in Section 7 : 12, 13 hook the single blocks to a strap, or to a lashing doubled, which they lay across the breast and both cheeks of the carriage.

Place the plank - 8, 9 place it as directed in the first part of this Section, its upper surface should be so high, that, when the gun is made to mount, the trunnious should be clear of the upper step of the carriage ; should there be any doubt as to this, 2, 3 place two thin wedges on the breast transom, and 6, 7 two handspikes parallel to, and just inside of each cheek, on which the piece of skidding is placed, and on it the rear end of the plank ; 6, 7 place the quoin on the stool bed which is under the plank, they put a fourteen inch roller under the chase ; 2, 3, 4, 5 raising the muzzle for this purpose.

Man the tackles -by all the men except 8, 9.

Haul away—the gun is made to mount ; when the trunnions are about arriving over the trunnion holes ; 6, 7 each places the point of a handspike in the holes, and the trunnions will rest on them.

The muzzle is borne down, or the breech heaved up, which will disengage the roller ; 8, 9 remove the plank, and the breech is allowed to descend on a handspike, or on a small piece of skidding, placed by 6, 7 across the upper step of the carriage.

The muzzle is then raised, the handspikes withdrawn from the trunnion holes, and the gun allowed to descend into its place.

SECTION 9.

TO DISMOUNT A GUN FROM A GARRISON CARRIAGE, BY TURNING THE CARRIAGE OVER, AND ALSO TO MOUNT IT.

With an 8 feet lever, one Non-commissioned officer and four men.

With 8 handspikes, one Non-commissioned officer and 8 men.

1st. *With a lever.*

Prepare to dismount the Gun—2, 3 raise the breech; 1 removes the bed and quoin, and the breech is lowered on the hind axletree.

Prepare to raise the right side of the Carriage—5 places the stool-bed as a fulcrum at a proper distance from the fore axletree arm; 2, 3 place the lever under the arm, and bear down; 4 shoves the quoin under the fore truck; fresh purchases are taken and 4 continues to thrust the quoin under, until the truck rests on the butt end of the narrow side; 1, 5 assist if necessary at the lever.

The lever is then applied under the cheek of the carriage for heaving up, and close in rear of the fore axletree; 4 assists by applying a handspike under the cheek, in front of the rear truck, double manned by 5; 1 assists at the lever.

Heave—they heave together, and the oarriage will be turned over, and the gun fall out.

2d. *With handspikes.*

2, 3 apply their handspikes, double manned by 4, 5, under the fore axletree arm as before; 8, a handspike under the cheek behind the fore axletree, and 9, one in front under the same axletree, and close to the shoulder; 6, 7 attend to the stool-bed and quoin.

The operation proceeds as before.

2 and 3 then apply their handspikes under the cheek; 8 applies his close to the hind truck, double manned by 6; 9 as before, double manned by 7; they all heave up, and the gun is thrown out.

To mount the Gun.

One Non-Commissioned Officer and thirty men for a 24 pounder.

2 pieces of 3½ *or* 4 *inch rope, each about* 12 *fathoms long.*
5 *handspikes.*

2 *drag ropes, if necessary, and should the carriage have no capsquares,* 1 *lashing rope, or drag rope, about* 30 *feet long.*

The gun is to be placed vent downwards, the muzzle being raised sufficiently off the ground by the bed and quoin, to allow of the ropes being passed conveniently under it.

2, 3, 4, 5, 6, 7, reverse the carriage over the gun, the trunnions in the trunnion holes.

Fix the bowsing ropes—12, 13, both on the side to which the gun is to be hauled over to, each fixes a bowsing rope to the carriage; 13 to the eye bolt, and 12, to the fore axletree, inside of the truck; they pass the running ends under the gun; one about the middle of the first reinforce, and the other near the chase girdle to 6, 7, who haul the ropes taught. and pass them over the carriage back to 12, 13; the ends are now stretched out, and manned by 8 and the following numbers.

Should there be no capsquares, 8, 9, 10, 11, pass a lashing round the gun and carriage, close to the trunnions, and in rear of the fore axletree, hauling taught and making fast.

Haul away—the men haul; 2, 3, 4, 5 assist with handspikes to heave the gun up; 6, 7 shove the bed and quoin under the gun as it rises.

When the axletree becomes vertical, the men will haul gently, and the carriage will fall on its trucks.

The foregoing operations are not advisable with iron carriages.

SECTION 10.

TO SHIFT A GUN FROM ONE TRAVELLING CARRIAGE TO ANOTHER, MUZZLE FOREMOST.

One Non-Commissioned officer and 18 men.
8 *or* 10 *handspikes.*
2 *gun rollers or* 3—14 *inch rollers.*
2 *drag ropes.*
2 *single lashings.*
The quoins of the carriages.
4 *or* 8 *scotches.*

1*st.* *The carriage with the gun limbered up.*

Prepare to raise the breech—2, 3 place handspikes in the bore, double manned by 4, 5; 12, 13, 14, 15, apply others under the breech.

Bear down—7 places a gun roller under the reinforce, and as near as possible to the centre of gravity of the gun.

Ease off—lift—6, 7 place a quoin on the breast transom.

Lower.

The spare Carriage is then run back by 2, 3, 4, 5, 6, 7, 8, 9, until the upper surface of its cheeks touch the breast of the other carriage; 7 raises the semelle of the spare carriage as high as the upper surface of the breast transom of the carriage the gun is on; 6 placing a handspike under and across the cheeks.

Scotch the wheels—by 6, 7.

Fix steadying handspikes—by 8, 9.

Fix breech and muzzle ropes—by 10, 11.

Raise the muzzle—2, 3, 4, 5 raise the muzzle by applying handspikes under it, and using the cheeks of the spare carriage as fulcrums; 7 withdraws the quoin, and 6 places a roller on the semelle of the spare carriage, and under the chase of the gun.

Lower.

Raise the breech—12, 13, 14, 15 raise the breech, and 7 shifts the breech roller behind the reinforce ring.

Ease off

The muzzle and breech ropes are now manned, the former by 2, 3, 4, 5, 10, 16, 17, 18, 19; the breech one by 11, 12, 13, 14, 15; and at the word *heave* the muzzle is hauled gently forward, till the trunnions come within a foot of the trunnion holes of the spare Carriage.

The steadying handspikes are removed.

The breech rope, without unhooking it, brought to the front by 11; the muzzle rope taken off and hooked to the neck of the cascable by 10, both ropes in the position for hauling the gun forward.

The right rope manned by 10, 12, 14, 16, 18, the left by 11, 13, 15, 17, 19. The handspikes are then applied to the bore, the muzzle lifted by 2, 3, 4, 5, 6, 7, 8, 9; the ropes hauled on, and the trunnions will slide into the trunnion holes.

Much must be left to the discretion of 1, who will direct handspikes to be applied when and where necessary; cause the rollers to be shifted; regulate the strength of the pull to get past obstructions; shift the muzzle rope to the breech, and vice versa, as the case may require.

To shift the gun breech foremost is the converse of the foregoing; great care is necessary in hauling at the breech rope, which must be done gently, otherwise the gun may overpower the men at the muzzle.

Should there be no semelles to the Carriages, or should they be damaged, a plank and rollers must be used, as when both carriages are unlimbered.

2d. Both carriages unlimbered.

1 *piece of broad 4 or 5 inch skidding in addition to the former implements.*

The breech is raised as before; 7 raises the semelle and 6 places a handspike under it, across the cheeks, and at about a foot from the rear bolt of the travelling trunnion holes; 7 places a gun roller under the first reinforce ring.

The muzzle is then lifted as before, and 6, or 7, places a quoin on the breast transom, on which the gun is to rest.

The spare Carriage is now run back by the first eight numbers, wheels scotched, semelle raised, and a handspike placed under it, at the distance of about a foot from the rear bolt of the travelling trunnion holes.

Fix steadying handspikes, and breech and muzzle ropes.

Raise the muzzle—7 withdraws the quoin from the breast transom, and 6 places a roller under the chase of the gun.

The breech is again raised, 6 lays the skid lengthwise on the semelle and 7 places the roller on it, at the first reinforce ring.

The muzzle and breech ropes are manned, and the gun drawn forward, shifting the rollers as the case may require, until the trunnions be within a foot of the trunnion holes; the steadying handspikes are cast off; the breech rope is brought to the front and the muzzle rope hooked to the neck of the cascable as before; the muzzle lifted, the ropes hauled on, and the trunnions will slide into the trunnion holes.

3*d*. *By a plank and rollers, both carriages unlimbered, muzzle foremost.*

The gun is to be well raised out of the trunnion holes by the usual process.

The spare carriage is run back as before and the wheels scotched.

Place the plank—6, 7 lay it on the breast transom of the front carriage, and shove it along until it come directly under the base ring of the gun; 10, 11 receive it, and assist 6, 7 in placing it in the middle between the cheeks, and resting on the front transoms of both carriages; and, to give the plank additional support, 7, 11 raise the semelles of the carriages till they touch the under surface of the plank, and, to keep them in that position, 6, 10 place handspikes underneath, or quoins, which bear on the head of the elevating screw.

The steadying handspikes and muzzle and breech ropes are now fixed.

The breech is then raised, and 7 places a roller in rear of the first reinforce ring; the muzzle is lifted, and 6 places a roller under the middle of the chase.

The ropes are now manned, and the gun made to move forward; the rollers are removed; the ropes cast off; the plank drawn out to the rear by 10, 11, and the gun lowered into its place on the new carriage.

The gun can be shifted breech foremost by the converse of the preceding; 2, 3, 4, 5, 10 manning the muzzle rope, and 11, 12, 13, 14, 15, 16, 17, 18, 19 the breech one.

SECTION II.

TO SHIFT A GUN FROM ONE GARRISON CARRIAGE TO ANOTHER.

One Non-Commissioned officer and eighteen men.

8 *handspikes.*

3 14-*inch rollers.*

1 *plank, or instead of a plank* 4 *or* 5 *handspikes.*

2 *drag ropes.*

2 *single lashings.*

4 *scotches or wedges.*

2 *short skids, should the stool-bed be fixed to the carriage.*

Prepare to raise the Gun—the gun is raised by the usual process; a handspike is laid under the gun, and across the cheeks of the carriage.

The spare carriage is placed either in front or rear of the other (suppose in front) the breast of one carriage touching the trail of the other.

Scotch the trucks—by 6, 7.

Fix steadying handspikes—by 8, 9.

Place the plank—if from the front by 6, 7; if from the rear by 10, 11; all of them assisting; it is to rest on the transoms of both carriages; the stool-beds or two skids, to be placed under it, in order to support it, one on the second step of the front Carriage, and the other on the rear carriage under the end of the plank; 6, 7 do this at the front, and 10, 11 at the rear; the under surface of the plank ought to bear upon them.

Fix muzzle and breech ropes—by 10, 11.

Two 14-inch rollers are now to be placed under the gun and on the plank by 6, 7; if the gun is to be hauled to the front, one of them under the middle of the chase, the other under the middle of the second reinforce; but if to the rear, one is to be just in front of the trunnions, and the other in front of the vent astragal. The muzzle and breech ropes are manned, as in Section 10, and the gun moved to the front, or rear, as the case may be: when the trunnions are over the trunnion holes of the new carriage, the rollers are withdrawn; a handspike is then laid across the cheeks of the carriage, for the breech of the gun to rest on; the plank is removed, the steadying handspikes, and the muzzle and breech ropes cast off, and the gun lowered into its place.

Instead of a plank, 4 or 5 handspikes may be used; they are to rest on the transoms of both carriages, and be supported in their middle, but being shorter than the plank, the rollers have only a length of six feet to move on: when therefore, the gun has passed over this length, it must be supported by pieces of skidding laid across the carriages under the chase and under the breech, and made to advance by applying handspikes on the cheeks of the carriage, and pinching it or rowing it along.

SECTION 12.

TO SHIFT A GUN FROM A TRAVELLING TO A GARRISON CARRIAGE, AND VICE VERSA.

One Non-commissioned officer and eighteen men.
8 *or* 10 *handspikes.*
3-14 *inch rollers.*
1 *plank.*
2 *short skids.*
2 *drag ropes.*
2 *single lashings.*
4 *or* 6 *scotches.*
1 *spade and* 1 *pick.*

The travelling carriage must always be in rear of the garrison carriage, and the upper surface of their cheeks ought to be on a level; for this purpose a trench must be dug in order to receive the wheels of the travelling carriage, or the garrison Carriage, raised by skids or planks placed under the trucks.

The gun is to be raised out of its carriage; the plank placed and properly supported; the steadying handspikes, and breech and muzzle ropes fixed; and the operation of shifting the gun is to go on exactly as detailed in the preceding Sections.

SECTION 13.

TO MOUNT A GUN ON A GARRISON CARRIAGE BY PARBUCKLING AND ALSO TO DISMOUNT IT.

One Non-commissioned officer and eighteen men.

8 *or* 10 *handspikes.*
2 *parbuckling skids.*
2 *pieces of short skidding, each about* 9 *inches by* 6.
2 *parbuckles.*
2 *single lashings.*
2 *drag ropes.*
4 *wedges.*

The carriage is to be placed parallel to the gun, the trunnion holes opposite to the trunnions.

Place the skids, and fix parbuckles—one end of the front skid is to be placed just in front of the trunnion holes, and one end of the rear skid just before the base ogee, both skids parallel to each other, and perpendicular to the Carriage; the ends which rest on the Carriage are not to project beyond the inside of the cheeks; 8, 10 place the front skid, and 9, 11 the rear skid.

If the gun be lying on the ground, the thick end of quoins, placed so as to overlap, or butt on the ends of the skids which are next the gun, will facilitate its ascent at the commencement of the operation. The standing end of the rear parbuckle is fastened to the eye-bolt of the carriage by 13, and that of the front one to the fore axletree by 12, they are passed over the carriage, and under and round the gun by 6, 7, who hand them back again to the opposite side of the carriage to which the gun is on to 12, 13; 6, 7 attend to the parbuckles. A piece of short skidding is placed across the trunnion holes by 6, and another across the upper step of the carriage by 7 ; their upper surface should be on the same level as the bevelled end of the parbuckling skids.

Prepare to parbuckle the gun—2, 3, 4, 5 apply their handspikes under the gun to assist in rolling it on the skids; the parbuckles are stretched out and manned by all the other numbers ; the even numbers at the muzzle parbuckle, and the odd numbers at the breech parbuckle.

Heave or haul—they act accordingly, until the word *hold on*, which will be given when the breech is too far forward. It is now necessary either to lower the breech or to raise the muzzle ; if the word *lower the breech* be given, 4, 5 shift to the other side of the gun, and pinch the breech back, the breech parbuckle being slacked off; 2, 3 scotch or check the chase on the lower side ; the muzzle parbuckle may be gently hauled on.

If the muzzle is to be heaved up, at the word *heave up the muzzle*, 4, 5 scotch or check the breech on the lower side, the breech parbuckle men holding on ; 6 or 7 places a handspike in the bore, and they man it with other numbers if necessary ; 2, 3 apply their handspikes on the skid, in order to pinch the gun forward ; the parbuckle men stand prepared to haul ; at the word *heave* they act accordingly. When the gun is in a position to be again moved forward, the word *haul or heave of all* is repeated and so on until the gun arrives at the top or bevel of the skids, at which place the trunnions ought to be vertical, and opposite the trunnion holes, with the vent outwards.

Should the gun be not in this position, it must be slewed until it is, by 8, 9 applying a handspike with a lashing to one of the trunnions ; but every thing depends on 1, who by judiciously lowering the breech or raising the muzzle, can place it in any position he chooses.

The gun is now pinched or allowed to roll on the short skids, care being taken to check it, by applying handspikes on the short skids, according to the side, 2, 4 pinch it over, and 3, 5 check and vice versa ; 6, 7 then scotch it with wedges.

Remove the skids and parbuckles—the skids and parbuckles are removed, and the gun is then lowered into its place.

With iron carriages, 3 or 4 thin wedges are very necessary; they are laid on the top steps of the carriage in order to bring the upper surfaces of the parbuckling skid, and the short skid which is placed across the cheeks of the carriage, horizontal, and also to prevent the skids from slipping to the rear.

The most easy and expeditious mode of dismounting the gun is breech foremost over the trail as in Section 8; for which purpose a plank and rollers will be required; but for the purpose of exercise it ought also be done by parbuckling, and would be exactly the converse of the foregoing.

Should the short skids on which the gun rests after being raised out of the carriage, be lower than the levelled ends of the parbuckling skids, the ground ends of the last must be lifted by 8,10; 9, 11, which will bring their carriage ends nearer on a level with the short skids; as soon as the gun has been rolled on the parbuckling skids, their ground ends are again to be lowered, or the points of the handspikes may be laid on the short skids in order to raise the gun high enough.

SECTION 14.

TO MOUNT A GUN ON A TRAVELLING CARRIAGE BY PARBUCKLING.

One Non-commissioned officer and eighteen men.

In addition to the implements enumerated in Section 13, there will be required,

1 *fulcrum.*

2 *or* 3 *pieces of short skidding.*

2 *double lashings.*

The position of the carriage with respect to the gun is the same as in Section 13.

1*st.* *When the carriage is unlimbered.*

Take off the right or left wheel—the wheel next the gun is taken off and laid on the ground with pieces of skidding placed on the nave to support the axletree, as in Section 6.

Place parbuckling skids—the front one is placed by 8, 10, close to the breast of the carriage, resting on the cheek; the rear one by 9, 11, is for the moment placed in front of the travelling trunnion hole.

Fix parbuckles—the front one round the axletree, as in Section 13; the rear one is made fast round the outer cheek.

Place the short skids—6 places the front one across the firing trunnion holes; 7 turns up the elevating screw, until the semelle becomes horizontal; when, assisted by 6, he places a short skid across the cheeks, bearing on them, and also on the semelle.

12, 13, 14, 15, each on their respective sides, place common quoins on this skid, the flat sides downwards, the butt ends bearing on the skid, and the points resting on the bolts in rear of the travelling trunnion holes; their upper surface will be nearly horizontal; they are to be lashed in this position to the cheeks of the carriage by the above numbers; 6, 7 place a short skid across the quoins near the butt ends, and 9, 11 the end of the parbuckling skid also on the quoin and touching the short skid; the foregoing arrangement is necessary in consequence of the slope of the cheeks to the rear.

The parbuckling then proceeds as in Section 13; the wheel being replaced as in Section 6, after the gun has been lowered into the carriage.

2*d*. *When the carriage is limbered up.*

The carriage is to be so placed, that the rear of the firing trunnion hole should be a little in front of the front part of the trunnions.

The wheel is removed and placed as before.

The front parbuckling skid is to rest on the firing trunnion hole, and bear on the bevelled part of a handspike, placed in it by 6, or 7.

The rear skid is laid on the cheek, just in front of the angle where it slopes off towards the trail; 6, 7 place the short skids just within and touching the parbuckling skids.

The parbuckling is now proceeded in.

When the gun is brought to rest on the short skids, and the long skids have been removed; in order to lower the gun into the carriage the muzzle must be first raised, and the front short skid placed in the firing trunnion holes.

3*d*. *When the carriage is dismounted.*

In this position the axletree rests on the ground, and the gun can be mounted with the greatest facility; the skids do not require to be longer than five or six feet; the wheels are taken off, and put on as in Section 6. The most easy and expeditious mode of dismounting the gun is breech foremost over the trail, as in Section 7; but for the purpose of exercise, it ought also be done by parbuckling, and would be exactly the converse of the foregoing. See remark at the end of Section 13.

SECTION 15.

TO MOUNT A GUN ON A TRAVERSING PLATFORM BY PARBUCKLING.

This can be performed two ways.

1*st*. *By parbuckling the gun at once into its carriage, as in section* 13.

2*d*. *By parbuckling the gun in the first instance on the epaulment, and afterwards passing it from thence on to its carriage, either on skids or rollers.*

1*st*. *When the gun is mounted by one operation.*

The same implements are required as in Section 13 but the skids must be 20 feet long; and should their scantling be slight, it will be necessary to support them in the middle by a trestle. The platform is to be traversed, so as to bring it as near as possible parallel to the epaulment, on which the parbuckle men are to stand.

The standing ends of the parbucles are fixed to the side of the platform which is opposite to that on which the gun is, and laid over the upper surface of the gun carriage.

The skids are placed, and every other part of the operations is the same as detailed in Section 13.

2*d*. *When the gun is mounted by a double operation,* and that several guns are to be mounted on the same battery they ought all to be parbuckled at the same place on the epaulment, and then in succession skidded along the superior slope opposite to their own carriages; 4 skids will be required for this part of the operation.

A plank should be laid along the crest of the epaulment, for the ends of the parbuckling skids to rest on, and thereby prevent the work from being damaged. If the gun is to be passed from the epaulment to its carriage on skids, it should be parbuckled with the muzzle towards the platform; but if on rollers, the breech ought to be towards the platform.

The skids for this purpose should be 10 feet long, and in addition to the implements already mentioned, there will be required 2 *picket posts.*

1. *Wood mallet.*

4. *Wedges.*

To parbuckle the gun on to the epaulment.

Place the plank, skids, and drive pickets—10, 11, who are on the epaulment, lay the plank, on the crest of it; 8, 9, 12, 13, 14, 15 place the parbuckling skids perpendicular to the epaulment; 8, 9 the ground ends; the other numbers lift them up to 10, 11, who receive and arrange them.

16, 17 lay the short skids to receive the gun from the parbuckling skids; 18, 19 drive two pickets firmly, a short way down the exterior slope of the epaulment, one of them opposite the chase of the gun, about a foot farther inwards than the neck astragal; and the other opposite the vent field.

Fix parbuckles—12, 13 made fast the standing ends of the parbuckles to the pickets, and give them to 6, 7 who pass them round the gun as usual, and return them to 12, 13; they are to be manned by all the numbers except the first six.

Heave and haul—the gun is brought on to the parapet; and rolled about six or seven feet on to the short skids.

When the gun is passed to its carriage on skids.

As 2, 3, 4, 5 are with the gun, which is now on the epaulment, 12, 13, 14, 15 come down and traverse round the platform as much as possible towards the parapet; the trucks scotched, and the carriage run up to the front of the platorm; the gun is to be parallel to it.

Place the skids—12, 13 place a short skid across the 2d step of the gun carriage, with a quoin underneath resting on the stool-bed; 8, 9, 10, 11 place the epaulment skids; the front skid is not to bear on the carriage, it is to project about a foot beyond the crest into the work; the breech skid is to be placed on the upper step of the carriage, its end resting on the off end of the short skid which has been laid across the 2d step.

In addition to the wedges for scotching the gun, when skidded into a proper position on the carriage, and as a matter of precaution, the parbuckles may be fixed and passed round the gun, so that they may check it when it is rolled from the skids on to the short skid; the parbuckles are manned by 8, 10, 16, 18; 9, 11, 17, 19—*heave*—2, 3, 4, 5, pinch the gun forward, and by degrees it is brought to rest on the short skid, vent upwards; the skids are now removed and the gun lowered into its place in the usual manner.

When the gun is passed to its carriage by a plank and rollers.

In addition to the other implements.

1 *plank.*

2 *or* 3—14-*inch rollers.*

4 *single lashings,* 2 *double lashings.*

2 *luff tackles.*

The gun and carriage should be perpendicular to the epaulment, their axis in prolongation of each other; the carriage is run up as close as possible to the parapet by 12, 13, 14, 15; the trucks scotched as well as those of the platform; the breech of the gun towards the carriage; vent upwards.

Place the plank, and short skid—drive pickets—fix the luff tackles—2, 3, 4, 5 raise the gun to allow of 6—7 placing two high blocks of wood, or the ends of two skids, one under each trunnion, by which the under surface of the gun will be quite clear of the parapet, and leave room for the plank to be passed under it; the ends of these blocks or skids must be distant from each other a little more than the width of a plank, in order to allow of its being passed between them; 12, 13 place a short skid across such step of the carriage, as that when the plank is shoved under the gun, it may be horizontal, and touch and bear equally on the short skid, the breast transom of the carriage, and the work.

6, 7, on the parapet, pass the plank between the cheeks of the carriage to 12, 13, who are on the platform.

Place the Rollers—the gun is raised and two fourteen inch rollers placed under it, one of them just in front of the second reinforce, the other at the vent astragal; 6, 7 re-remove the blocks or skids from under the trunnions, and 8, 9 fix the steadying handspikes; whilst the foregoing has been doing 18, 19 drive a picket into the superior slope in prolongation of the axis of the gun, and make fast the single block of a luff tackle to it; 2, 3 pass a double lashing round the neck of the piece, and 10 fixes the double block to it.

14, 15 pass a double lashing through the eye-bolts at the trail of the platform, secure its ends by a right knot, and hook the single block of another luff tackle to the rope; 11 passes a single lashing through the breech loop, and hooks the double block of the same tackle to it.

Man the tackles—the Nos. from 11 to 17 man the breech tackle; 2, 3, 4, 5, 10, 18, 19 the muzzle tackle.

Haul the breech—the gun is to be hauled to the rear until the trunnions be over the trunnion holes.

The tackles are then cast off; the gun raised; the rollers and plank taken away; the short skid removed one step higher up, and the breech allowed to descend on it.

The gun is then lowered into its carriage as usual.

The gun can be dismounted by the converse of the foregoing operations.

SECTION 16.

TO MOUNT, AND TO DISMOUNT A GUN WITH A LEVER AND BOXES, OR BLOCKS OF WOOD.

One Non-commissioned officer and ten men.

The principle on which this manœuvre is founded, is that, of alternately lifting the breech and muzzle of the gun, and placing blocks of wood under it, until it shall have been raised as high as required.

Boxes are preferable to blocks of wood as being much lighter and more easy of transport; they are open on one side and are of elm, a set consists of the following.

	Length.	Breadth.	Depth.	
Boxes	26	22	12	Of 2½ inch plank for sides, and 3 inch for bottom.
	16	16	16	
	16	12	8	of 2½ inch plank.
Blocks	16	8	4	
	16	6	2	

In placing them, one on the top of the other, the grooves which are cut from top to bottom, on their front and rear sides, must always be made to coincide.

The collars are 16 inches long, 5 inches wide, and 5 inches deep; they are excavated for about 2½ or 3 inches of their depth, in order to fit the gun and the edges of the under side rounded off.

Two pieces of girth web, about 17 inches long each, are required for each collar, one end of which is nailed to the end of the collar, and the other end has a ring attached to it.

4 pieces of quilting line for the above. Instead of web, a leather strap may be nailed to each end of the collar, one of which has a buckle attached to it.

Instead of boxes, pieces of plank will answer the purpose: but a great number of them would be required, and each piece should be a little less in width than the one immediately below it, in order that the pile may be more stable.

1 *round lever of* 12 *feet.*

4 *common handspikes.*

A set of boxes is to be placed by 6, 7, on each side of the gun; one set opposite the chase girdle, and the other opposite to the first reinforce ring.

If the gun be in Battery, it must be brought across the platform, or else made to point to the rear, for the purpose of giving room for the working of the lever.

The operation is only applicable to garrison carriages.

Suppose the gun is to be dismounted—on the word *prepare to dismount the gun*—2, 3 place the lever about 18 inches in the bore, and assisted by 8, 9, 10, 11 will at the word *bear down*—bear down the muzzle, to allow 7, 4 to pass a collar under the gun, and fix it 8 or 9 inches behind the trunnions. 6, 5 fix another collar in point of the trunnions; it should be so placed, that, a line dropped from the rear part of it, would fall clear of the transom and axletree of the gun carriage. 1, must be careful to see that the middle of the collars coincide with the plane passing vertically through the axis of the piece.

When the collars have been fixed, 6 removes the quoin and 7 the stool-bed.

Ease off—the lever is allowed to rise, and the breech of the gun will rest on the hind axletree.

Place the front Boxes—6 places the twelve inch box touching the fore axletree; on the top of it, the sixteen inch box, then the eight inch, and if necessary, the four, and the two inch blocks, the middle line of all of them coinciding with the axis of the carriage; 7 assists him.

Bear down—the lever men bear down, assisted by 6, 7, each of whom applies a handspike under the breech; the gun will be by this means raised out of the carriage, which, when clear, is to be instantly run back by 6, 7, until the breast transom be under the base ring.

Place the rear boxes—they are placed by 7 assisted by 6 and arranged in such a manner as to be two or four inches lower than the front set; they then run the carriage back entirely clear of the gun.

Ease off—the breech is allowed to descend on the rear boxes.

1 gives the word *lift*, when any of the front blocks or boxes are to be withdrawn, and then the word *lower*, when the gun is to be allowed to bear on them; and the word *bear down*, when any of the breech boxes are to be withdrawn, and then the word *ease off*—he will give these words alternately, and will direct what blocks or boxes are to be removed, or to be put under the gun, so as to diminish the height two or four inches at a time.

When 6 withdraws a block or box, 7 puts in the one ordered and vice versa.

The lever men are only to lift, or bear down, so much, as just to allow the blocks, or boxes, to be easily disengaged or to be replaced, and it must be done gently and steadily.

The upper surface of the lower boxes must always be horizontal, and the middle line of both front and rear boxes must correspond.

It may sometimes be advisable to lower the guns four inches at a time; but it is to be recollected, that when raised or lowered too much at one operation, and when it is to rest on the rear blocks, the centre of gravity may be thrown beyond the blocks, and the gun consequently slide off.

The placing of the rear collar must depend on the length of the gun, the nearer it is to the trunnions, the operation will, of course be easier; but, if the rear blocks be placed too near the trunnions, the breech may preponderate when the muzzle is lifted, and the gun slip off entirely to the rear.

The operation of mounting the gun is exactly the converse of the foregoing.

When it has been raised high enough, and is resting on both sets of boxes, 6, 7 run the carriage forward until the breast transom be under the breech of the gun, or until it be close to the rear set of boxes. The men at the lever then bear down the muzzle, and the rear set of boxes is entirely withdrawn by 7; 6, 7 then run the carriage up, until it touch the front set of boxes; after which the muzzle is allowed to rise, and the breech to descend on the hind axletree of the carriage.

The front set of boxes are then removed, and the trunnions will be lodged in their places; the muzzle is then borne down, 7 places the stool-bed, and 6 the quoin, and the breech is allowed to descend on them.

SECTION 17.

TO RIGHT A GUN MOUNTED ON A TRAVELLING CARRIAGE WHICH MAY HAVE BEEN OVERTURNED, OR IS TOPSY TURVY, OR COMPLETELY TURNED OVER.

One Non-commissioned Officer and twenty-four or thirty Men.

2 *ropes about* 72 *feet long each.*

1 *rope, about* 30 *feet long for lashing.*

1 *pair of drag ropes.*

8, 9, 10, 11 secure the gun to the carriage by a lashing rope, passed round the vent astragal; 2, 3, 4, 5, with their handspikes, heaving the breech up as close as they can to the carriage.

Fix the hauling ropes—the standing ends are secured round the axletree of the carriage, close to the cheek; the running ends are then passed under the gun, and brought through between the two lower spokes of the wheel on the other side; then up outside of this wheel, one on each side of the nave, made to cross each other on the tire of the same wheel, and handed over the other wheel, where they are stretched out and manned; 6, 12, 7, 13 do this on their respective sides; if 6, 12 secure the standing ends, 7, 13 pass them through the spokes of the wheel, and hand them over both wheels to 6, 12 and vice versa.

8, 9 fix a drag rope to the trail.

Prepare to turn the gun over—2, 3 apply their handspikes under the wheel that is to be turned over; 4, 5, 6, 7 stand to the same wheel to lift it; 8, 9 attend the trail drag rope.

The rest of the Men are at the hauling ropes.

Heave and haul—the Men with the handspikes, and at the wheel, heave it up; those at the ropes haul; as soon as the carriage has been lifted a little, 2, 3, 4, 5, 6, 7 immediately run to assist 8, 9, and prevent the trail from swinging round, which it otherwise would do, and might cause an accident.

The gun is then to be hauled steadily over, until it falls on the other wheel, and is righted.

Although this may be expeditiously performed by twenty-four or thirty men, yet, as it causes a great strain on the wheels, it should never be resorted to except in cases of necessity.

As the overturning of a gun and carriage, for the purpose of exercise, is out of the question, the carriage without the gun on it, may be brought into a proper position for the manœuvre, by scotching the wheels, fixing ropes to the trail, and then turning the latter over like the perch of the devil carriage, so as to bring the upper side of the carriage undermost ; it is then to be run over the gun, which is supposed to be lying vent downwards, and raised by placing skids under it, until the trunnions are properly lodged in the trunnion holes, and the capsquares keyed.

The lashing is then to be passed round the carriage and gun at the vent field, and the operation proceeded in as before.

SECTION 18.

TO MOUNT AND DISMOUNT MORTARS ON AND FROM THEIR BEDS.

13 inch.... 14 Men }
10 ,, ... 8 ,, } and one Non-commissioned officer.
8 ,, ... 4 ,, }

4 *handspikes.*

2 *drag ropes.*

1 *wrench.*

1 *hammer.*

The capsquares are first removed by 2, 3, 4, 5.

The mortar is supposed to be lying vent upwards, breech towards the bed, the breast of which is towards the mortar.

Raise the mortar on its muzzle—6, 7 each hooks or fastens a drag rope to the dolphins or if none round the chase; they pass the ends under and bring them up behind the trunnions; and lead both ropes to the front or muzzle of the mortar, where they are to be manned by all the numbers except the first four, who will apply their handspikes under the trunnions for the purpose of heaving them up; 1 stands with the quoin to push it under the breech in proportion as the mortar is heaved up.

Heave and haul—the handspike and drag rope Men act accordingly, and bring the mortar on its muzzle.

Run the bed up—2, 3, 4, 5, with the 13 inch, and 2, 3, with the 10 and 8 inch, run the bed up, until its front part be within 6 inches of the mortar and fair for the mortar to fall into it.

Shift the drag ropes—the drag ropes are shifted from the dolphins or chase to the trunnions, and stretched out to the rear, manned as before; 4, 5 place their handspikes across the mortar, and under the dolphins, the points bearing on the platform; 2, 3 apply theirs under those of 4, 5, the points towards the rear.

Heave and haul—the whole act together, and the mortar will fall on the front transom; 2, 3 shifting their handspikes into the bore as soon as they possibly can, 4, 5 crossing theirs under those of 2, 3, in the front of the face of the mortar.

The mortar is then, by the united efforts of the handspike and drag rope men, brought into its proper situation; after this the mortar is to be brought vertical, for which purpose, at the word *bring the mortar vertical*, 2, 3, 4, 5, with the 13 inch, 2, 3 with the 10 or the 8 inch, each puts the point of his handspike as far in the bore as possible, and stands ready to lift; 6, 7 with the 13 inch, and 4, 5 with the 10 and 8 inch, each fastens a drag rope round the small ends of the handspikes, and pass them to the rear, where they are to be manned, at the thirteen inch by the Men from 6 to 13, at the ten inch from 4 to 7, and by 4, 5 at the eight inch.

The Men at the handspikes stand ready to heave the muzzle up.

Heave and haul—they act accordingly, and the mortar will be brought to a vertical position, in order to allow the capsquares to be replaced, which are to be put on by the Nos. who took them off; 6, 7 put in the quoin.

DISMOUNTING.

The mortar is brought to a vertical position, as above detailed and the capsquares taken off.

Fix the drag ropes—6, 7 hook or fasten the drag ropes together, and place the junction of the two against the under the side of the mortar, close up to the muzzle ring, stretching them out to the rear, where they are to be manned as before.

Heave and haul—they give a smart pull; 2, 3, 4, 5, with the thirteen inch, and 2, 3, with the ten and eight inch, shoving at the muzzle; the mortar will then be drawn to the rear and will light on its muzzle.

N. B.—4, 5 at the ten and eight inch mortars, will do the duties which have been detailed above for 6, 7 at the thirteen inch.

A mortar resting on its muzzle can be slewed by making fast a handspike to each trunnion, and heaving on the small ends.

A dismounted mortar lying on a platform or hard surface, may be moved in the direction of its axis, by placing a handspike under and behind each trunnion for heaving, and two on each side under the middle of the chase in the position for rowing or cross lifting; a fulcrum to be placed under each of the latter.

SECTION 19.

TO MOUNT AND TO DISMOUNT HOWITZERS AND SHIFT THEM FROM ONE CARRIAGE TO ANOTHER.

10 inch howitzer 18 men } and one non-commissioned
8 ,, ,, 12 ,, } officer.

1 *Lever.* 12 *or* 14 *feet.*
4 *or* 6 *Handspikes.*
2 *Fulcrums.*
2 *pair of Drag-ropes, or* 1 *pair and a parbuckling Rope.*
2 *or* 3 *thick pieces of skidding.*
1 *Hammer.*

To raise a 10 *inch Howitzer on its muzzle.*

The howitzer is supposed to be lying on the ground vent upwards.

1*st. With Drag-ropes.*

Prepare to raise the breech—4, 5 place the fulcrums, and 2, 3 apply their handspikes under the button, or under the neck of the cascable, 4, 5 double man them.

Bear down—they act accordingly, and 6, 7 place a short skid under the howitzer, shoving it as close to the trunnions as they can.

Ease off—they then take a fresh purchase and the skid is shoved still nearer to the trunnions ; 2, 3, 4, 5 each takes a purchase with a handspike under the base ring ; the breech is raised, and 6, 7 shove the skid in still farther, or place a second skid on the top of the first, and they thus proceed until the breech is raised so high, that the axis of the piece forms an angle of 25 or 30 degrees with the horizon.

Hook Drag-ropes to Cascable—6, 7 place the middle of a lever or handspike under and across the neck of the cascable, which they man together with 8, 9, 10, 11 ; 4, 5 each hooks the end of a drag-rope round the neck of the cascable, and round the handspike ; if it be a parbuckle, they make a close hitch in the middle of it, and pass it on the handspike and neck of the cascable, hauling the hitch taught ; the ends are stretched outwards to the muzzle and the rope manned by 2, 3, 4, 5, and the men from 12 to 19 ; they diverge outwards, which prevents the howitzer from inclining to one side or other, when it is being raised.

Prepare to raise the Howitzer on its muzzle—they all stand ready.

Heave and haul—they all act together: those at the rope hauling, and the handspike men heaving up, and the howitzer will be raised on its muzzle; the rope however is not to be quitted until the howitzer be perfectly firm; when it is about to bear on the muzzle, 2, 3, 4, 5 walk in, still holding the cascable rope, and steady the breech with their hands; 6, 7 withdraw the handspike or lever from the cascable, and remove the short pieces of skidding and the howitzer is ready for mounting.

2*nd*. *By means of the Travelling Carriage.*

The first mode requires great exertion on the part of the men, but it is more expeditious than the second mode, which is however safer and easier.

The howitzer is supposed to be lying vent downwards. The breech is raised as before, and a handspike laid by 6 across the howitzer, and under the vent field, so that there may be space enough for a rope to be passed under the piece; the breast of the carriage is towards the muzzle of the howitzer.

Run the carriage over Howitzer—This is done by all the numbers except the first six; 18, 19 at the pole, it is to be run over the howitzer until the axletree be over the middle of the chase; *halt—scotch the wheels*—16, 17 do this with handspikes.

If the carriage be limbered up, *prepare to unlimber* 8 unhooks the draught chain, 10, 11, 12, 13, 14, 15, 16, 17, stand to the trail, 18 and 19 at the pole.

Unlimber—the howitzer is unlimbered.

Fix the Guy Ropes—8, 9 each secures a drag rope to the trail, and carries the end to the front, when hauled upon, they are to be manned by 2, 3, 4, 5, 6, 7, 8, 9, 10 fixes another rope to the trail, and stretches it out to the rear; and then with all the other nnmbers except the first eight stand to the trail.

Lift the Trail—the men at the trail lift, and as it rises break off in succession, and man the rear rope; the men at the front ropes pull the trail up; when it is vertical, or rather a little inclined towards the front, *halt*—the trail rope is held well on by the men who man it; 2, 3, 4, 5 steadying it by the front one.

Whilst the carriage has been preparing for unlimbering, 6, 7 lay the parbuckle, or a piece of 4 inch rope, on the upper side of the howitzer, in rear of the first reinforce ring, cross the ends under it, making the first part of a reef knot, which is to be exactly on the under side of the howitzer, and bring the ends upwards; when the trail has been brought vertical, as already mentioned, the word is given, *secure the howitzer rope*—upon which 6, 7 place a three inch skid, or handspike, across the carriage, on the capsquares, behind and touching the front capsquare bolts, pass the end of the howitzer rope over it, and down inside between the cheeks, taking a turn round the axletree, where they are to be received by 8, 9 who assisted by 6, 7 haul them as taught as possible; 8, 9 bring them from the under side of the cheeks, and hold on.

Limber up—the trail is hauled down, and the carriage limbered up; this will cause the breech of the howitzer to rise.

Unscotch the Wheels—2, 3, 4, 5 take a wheel purchase with the drag-ropes.

Run the Carriage forward—the Carriage is run forward by all the numbers, which will bring the howitzer on its muzzle, 2, 3, 4, 5 breaking off from the carriage in time to steady the breech; the howitzer rope is then cast off, and the piece is ready for mounting.

Should the howitzer have had the vent up when raised as above, it must be slewed round.

To mount a 10 *inch Howitzer on a travelling carriage.*

The howitzer being on its muzzle, the carriage with the capsquares removed, is run up to it, perfectly square and the wheels scotched; it is then unlimbered, and the hail raised, precisely as already detailed; when the trunnion holes are opposite the trunnions *halt, push the howitzer on carriage*—this is done by 2, 3, 4, 5 when the trunnions are completely lodged in the holes.

Put on capsquares—2, 3, 4, 5 do this and key them.

Take a purchase under the muzzle—2, 3 apply their handspikes on a fulcrum, and apply the points under the muzzle, assisted by 4, 5.

Limber up, or *heave and haul*—they act accordingly; the front guy men coming round to the rear, to haul down the trail, and afterwards receive it, with the other numbers; as soon as they can do it, 2, 3 push the points of their handspikes into the bore, and heave or bear the muzzle up; but, when the trail begins to bear heavy on the men posted to it, they will bear down with their handspikes.

To mount a 10 *Inch Howitzer on a garrison carriage.*

The carriage is to be run forward by 2, 3, 4, 5, 6, 7, 8, 9 but only so near to the howitzer, that when the trail is lifted, the highest part of the Iron trunnion boxes may be just clear of the trunnions, and the trunnion holes correspond with them.

Scotch the trucks—6, 7 each places a handspike across the front and rear of the trucks.

Prepare to raise the trail.—6, 7 lay hold of the carriage at the trail, 8, 9 at the end of the cheeks, and 10, 11, between them.

Lift—the trail is lifted, and when the trunnion holes correspond with the trunnions, *halt.*

Push the howitzer on the carriage.—2, 3, 4, 5 do this and the trunnions are lodged in the trunnion holes.

Fix the drag-ropes—4, 5 each passes a drag-rope round the chase of the howitzer, so adjusted that the end comes out from the side of the piece; they then cross them from one to the other on the top of the howitzer over the first reinforce, hauling them taught and passing them to 6, 7, who stretch them out towards the trail, resting on the rear part of the cheeks, from which they will prevent them from slipping, they will then man them with all the numbers except 2, 3, 4, 5 who place their handspikes on a fulcrum, and apply them under the face of the piece as already detailed.

Heave and haul—they all act together, and the carriage falls upon the trail.

To dismount a 10 *Inch Howitzer from a travelling carriage.*

The wheels are scotched, the carriage unlimbered, the guy ropes fixed, and the trail raised up as already explained, with the exception that 2, 3 each places a handspike in the bore, to be double manned by 4, 5, and assists in raising the trail, by bearing the muzzle down : the trail is to be raised until the howitzer is brought to bear on the muzzle.

Unkey the capsquares—hook drag-ropes to cascable—4, 5 each hooks a drag-rope to the cascable and they stretch them out to the front, and man them with 2, 3.

Haul the howitzer out of carriage, or raise howitzer on muzzle—the drag-rope men haul the howitzer out ; if necessary 10, 11 assist them ; 6, 7, 8, 9 at the front guy ; 12, 13, 14, 15, 16, 17, 18, 19 at the rear guy, stand attentive to keep their ropes well checked.

Lower the trail, or limber up—the men at the front guy, assisted by 2, 3, 4, 5, ease off, and as the trail comes down, those at the rear guy, move in to receive it ; at the proper moment the front guy men hold well on with their ropes ; the carriage is then limbered up.

Run the carriage forward—as before detailed ; should there not be a limber, the trail must be held horizontally and carriage run back to be out of the way of the howitzer ; the trail is then lowered.

Prepare to lower the howitzer—6, 7 place a skid at such a distance from the muzzle, that when the howitzer is made to fall, the skid may be a little in rear of the centre of gravity.

Push the howitzer over—2, 3, 4, 5 push the howitzer to the rear, and it will fall on the skid; or it may be pushed to the front and fall vent downwards.

To dismount a 10 *Inch Howitzer from a garrison carriage.*

Scotch the trucks—prepare to raise the carriage.—10, 11 each hooks a drag-rope to the eye-bolts on each cheek near the trail ; they pass them under the cheeks behind the axletree, bring them up inside of the cheeks, and hand them to 12, 13 who stretch them out to the front ; these ropes are manned by all the numbers from 12 to 19 ; 6, 7 lay hold of the cheeks of the carriage at the trail blocks ; 8, 9 the rear of the cheeks, and 10, 11 between them, at the axletree or hind transom.

Heave or lift—the men act accordingly, until the trail of the carriage is raised, and the howitzer is brought to bear on its muzzle.

Hook drag-ropes on cascable—to be done by 4, 5 who stretch them out, and man them with 2, 3, 14, 15, 16, 17, 18, 19; 12, 13 apply handspikes on the cheeks of the carriage and under the breech, in order to disengage the howitzer with greater ease from the trunnion holes.

Haul out the howitzer, or raise howitzer on muzzle—They act occordingly, 2, 3, 4, 5 stepping in to steady the cascable ; 6, 7, 8, 9, 10, 11 who are at the trail, lower it on the ground as soon as the howitzer is clear of the carriage.

Run the carriage back—this is done by 6, 7, 8, 9.

Prepare to lower the howitzer—push the howitzer over—exactly the same as detailed with the travelling carriage.

To place an 8 *inch Howitzer on its muzzle.*

This is done precisely as detailed for the 10 inch with the exception that only four men, viz. 6, 7, 8, 9 man the handspike under the neck of the cascable ; all the other numbers are posted to the dragropes, and when it is about to bear on its muzzle, 2, 3 step in to steady the breech. When, however, it is to be mounted on a travelling carriage it being shorter than the 10 inch howitzer, its muzzle will not touch or bear on the ground, until the trail, when raised, is brought beyond the vertical position to the front, which would prevent the howitzer, when dismounting it, from being hauled out, or when mounting it, from being properly lodged or secured in the trunnion holes, in order to raise the muzzle, it must therefore be made to rest on the points of two handspikes placed on the ground in front of the muzzle by 2, 3 in a direction parallel to each other, and to the axis of the piece. As the muzzle will not however rest fair on the handspikes when placed on them, the word is given *incline the breech to right, and then to left*-2, 3, 4, 5 move the breech accordingly, and 2, 3, arrange the handspikes so that the muzzle may be fairly on them, and the howitzer be vertical.

To mount an 8 *inch Howitzer on a travelling carriage.*

The howitzer resting on its muzzle ; the carriage with the capsquares removed, is run up perfectly square by all the numbers except the two first, 12, 13 at the pole and the wheels scotched by 6, 7.

Prepare to unlimber—8 unlocks the draught chain.

Unlimber—8, 9 fix the front guys and stretch them out to the front; 10 fixes the rear guy; they then all post themselves to the trail.

Lift the trail—they act accordingly, and as the trail rises the front guy men, 2, 3, 4, 5, 6, 7 run to their ropes and pull it up, and as it is about becoming vertical the rear guy men, 8, 9, 10, 11, 12, 13, break off, and man their rope; when in a proper position, *halt.*

Push the howitzer on carriage—to be done by 2, 3, 4, 5.

Put on capsquares, take a purchase under muzzle, limber up—all precisely as detailed for the 10 inch howitzer. To mount an 8 inch howitzer on a garrison carriage is performed, precisely as with a 10 inch, and the same numbers perform the same duties.

To dismount an 8 *inch Howitzer from a travelling carriage.*

The wheels are scotched, the carriage unlimbered, the guys fixed, and the trail raised precisely as for mounting the howitzer; 2, 3 each placing a handspike on the bore, and bearing down.

When the trail is nearly becoming vertical; *place handspikes for muzzle*—this is done by 2, 3, and the muzzle of the howitzer bears on them.

Unkey capsquares, hook drag-ropes—4, 5 hook drag-ropes to cascable, and with 2, 3, man them.

Haul howitzer out of carriage—they act accordingly, and the howitzer rests on its muzzle; they then fall into the front guy ropes.

Lower the trail, or *limber up—run carriage back—lower the howitzer,* or *push the howitzer over*—done precisely as with a 10 inch.

To dismount an 8 inch howitzer from a garrison carriage, is performed exactly as detailed for a 10 inch howitzer.

Howitzers can be shifted from one carriage to another in the same way as guns, always making use of the plank; yet, the operation is so long and troublesome, that when it is employed, it is solely for the purpose of drill, and for instruction in the application and use of the handspike.

The mode therefore to be followed is to dismount the howitzer from one carriage, and then mount it on the other in the manner above directed.

When the trail of the travelling carriage is raised, or when it is vertical, and in order to keep it steady, it may be found advantageous to drive a picket in front, and one in rear, about which a turn or two is to be taken with the guys, easing them off, or hauling on them, according to circumstances; and when the trail is in a proper position, making them fast to the pickets, thus keeping it steady.

SECTION 20.

DIFFERENT MODES OF MOUNTING GUNS.

1st. *To mount a heavy gun, making the trail serve as a lever.*

The gun is supposed to be lying on the ground vent upwards; the breech raised as high as possible, by placing skids or blocks of wood under the second reinforce, just behind the centre of gravity; a large skid about six and a half feet long, and six and a half or seven inches square, is to be placed under and across it, at about 8 inches from the base ring, and secured to the breech by a strong lashing.

The carriage is then run forward until the wheels touch the skid, which is to be well lashed to the felloe of each wheel the skid being horizontal, the wheels scotched.

Guys are fastened to the trail of the carriage, which is then to be raised vertical in which position it is to be steadily kept, whilst a skid of the same dimensions of the former is laid on the tire of the hind part of the wheels, as high up as possible, that is, until it touch the under side of the cheeks of the carriage; in this position it is to be lashed to the fellies of the wheels precisely as the other skid was.

The wheels are now unscotched, and the trail of the carriage hauled down, until it bears on the ground, this will raise the breech of the gun,

The wheels are again to be scotched, the trail raised, and the rear skid cast loose and shifted, and fastened to the wheel as before, a twenty inch roller is placed in the trunnion holes, and a thirty-six inch roller held across the cheeks of the carriage behind the trunnion holes, on which the reinforce of the gun is to be received.

The trail is then hauled down which will raise the gun higher, and bring the trunnions nearly over the trunnion holes, and bearing on both rollers; the skids are unlashed, the gun pinched back if necessary, and lowered into the carriage.

Should the number of men not be sufficient to haul the trail of the carriage easily down, a small skid should be lashed under the cheeks near the trail, and a lever or beam of wood placed on the trail transom, the point or end of which is to be securely lashed to the middle of this skid ; it is also to be lashed to the trail ring; the guy ropes are to be fastened to the end of the beam, by this means the length of the lever is much increased.

When the trail is being raised, or when it is vertical, and in order to keep it steady, it will be found advantageous to drive a picket in front, and one in rear of the carriage, about which a turn or two is to be taken with the guys, easing them off, or hauling on them according to circumstances, and when the trail is in a proper position making them fast to the pickets, thus keeping it steady whilst the men are lashing the skids, &c. this mode of mounting a gun is however apt to strain the wheels very much.

2nd. To mount a gun over the trail of a travelling carriage, using the naves as windlasses.

The position of the gun and carriage, with the rollers, &c. is precisely as detailed in Section 8, for mounting it with luff tackles ; instead of which, however, ropes are used.

Two pickets are to be driven behind the trail of the carriage, touching the hind part of the hind transom, and close to the inside of each cheek ; the heads ought not to project above the upper surface of the cheeks.

The breast of the carriage is raised, by placing two props under the cheeks, their upper ends touching and bearing on the front of the axletree, the ground ends having a small inclination to the front ; from their position, and from the security afforded by the pickets at the trail, the carriage is kept very steady, the props should not be longer than to raise the wheels about one, two, or three inches from the ground. Two men witn a parbuckle or stout rope, makea large clove hitch in the middle of it, and put it on the button of the piece; two others then pass a skid about six feet long through the hitch between its lower part, and the under side of the neck of the cascable ; the hitch is to be hauled well taught so as to bind the skid firmly to the neck of the cascable ; the rope is then laid out on each side of the gun along the skid, and a second hitch taken round the skid about eighteen inches from the base ring, or just opposite the middle between the tire of the wheel, and the shoulder of the spoke ; the rope being well tightened, the skid to be horizontal.

The ends of the rope are then led to the nave, and passed twice round it going over the nave, down in front, then under it and to the rear, then over it again, and so on for another turn, bringing them to the front where they are to be held on by two men ; the steadying handspikes are now fixed.

Handspikes are then applied between the spokes of the wheels and under the cheeks, in the position for running the carriage up ; and two men will assist in heaving the gun forward, by applying handspikes under the breech skid ; they must all heave equally together, without jerking.

The operation is then proceeded in, and is exactly as detailed in Section 8.

3d. To mount a gun over the trail of a travelling carriage by making the carriage move forward.

Every arrangement, with regard to the position of the gun and carriage, the skid fixed to the neck of the piece, and rope passed round the naves of the wheels, is precisely as detailed in the second case; when the handspikes are applied to the wheels, to move the carriage forward, the breech of the gun must be heaved up, in order to keep it clear off the ground, and make it bear on the roller.

Drag-ropes are hooked to the breast of the carriage, for hauling it forward; or the felly purchase may be taken, stretching the rope out to the front over the tire of each wheel.

The operation is now proceeded in, as detailed in the second case.

4th.—*To mount a gun on its carriage by means of another gun already mounted.* The gun is supposed to be lying on the ground on a skid; the carriage on which it is to be mounted, is placed behind it with the breast towards the breech. The carriage by which it is to be mounted, and on which there is a gun already, is to be in front of the dismounted gun, with the breast towards the muzzle of the gun.

The mounted gun is then run over the dismounted one, so far as that the muzzle astragal of the former be over, or a very little behind, the centre of gravity of the latter; a piece of eight or nine inch skidding is then placed under each wheel, in order to raise the carriage as much as possible; or two trenches dug for the wheels of the carriage on which the gun is to be mounted, in order that the breast of this carriage may be brought sufficiently low, to allow it to pass under the trunnions of the gun.

The mounted gun is then elevated as much as possible, and a strong lashing passed three or four times round the breech and the cheeks of the carriage, tightening the turns with a racking stick; a lever or skid is then fastened to the trail of the carriage, as in the first case.

The trail is then lifted, until the under part of the swell of the muzzle of the mounted gun touch the upper surface of the dismounted one; the trail ought here to be propped by placing a handspike under each cheek, and one under the centre transom, sloping a little from the carriage towards the rear.

Three or four turns are then taken with a strong lashing round the mounted gun, just behind the swell of the muzzle, and round the dismounted one, at the centre of gravity, frapping together the returns of the rope between the guns.

The trail of the carriage is then hauled down, which will raise the dismounted gun nearly enough to allow of its being lodged in its own carriage, which is now to be run forward, as far under the gun as possible; the trail of this carriage is then raised, which will allow of its being run under the gun, until the trunnion holes be under the trunnions; the trail of the other carriage is then allowed to rise, and the gun will be lodged in its place.

When the gun is mounted by the foregoing mode, it is always preferable that it should be of a less calibre than the one which is already mounted.

TACKLES, INCLINED PLANES, PLACING GUNS ON TOWERS, OR GETTING THEM UP THE SCARPS OF WORKS, EMBARKING, DISEMBARKING, CRANES, DERRICKS, &c.

SECTION 1.

REMARKS, DIRECTIONS, AND GENERAL DUTIES OF THE MEN.

No regular words of command can be laid down for the operations; all must depend on local circumstances; nor is it possible, except within certain limits, to assign distinct and invariable duties to every individual, as with a regular machine.

When capstans are employed, the men for each capstan are to be numbered by themselves; they drive the posts, and fasten the capstans to them, pass the falls round the barrels, and make every necessary arrangement. Six men at least are required for every capstan; four of them, viz. 2, 3, 4, 5 for the capstan bars, and two to hold on the fall, one of whom, 6, eases off when ordered to do so, the other, 7, coils it up as it comes off; 2, 3, 4, 5 drive the post for the capstan and lash it to it.

Sometimes the fall requires to be shifted lower down the barrel of the capstan; when this is the case, the word *halt*, or *avast heaving*, is given, and the wheels of the gun carriage must be chocked, on the word *chock* or *scotch the wheels*

—when this is done, the word *shift the fall* is given, which is to be followed by that of *heave away.* When the fall is to be stoppered, the word is given *halt*, or *avast heaving*, and then *stopper the fall*, and when stoppered, *ease off*, or *slack off the fall*, and the weight is allowed to bear on the stopper; the necessary alteration having been made, *heave* or *haul away*—when the stopper gets slack, and the fall acts on the gun or weight, *cast off the stopper.*

When tackles are used, and the blocks approach too near to each other, or are block and block, the word *halt* is given, to be followed by that of *fleet the blocks*, or *overhaul the tackle*, or *take a fresh purchase*, and when separated to a proper distance, *heave away*, or *haul away.*

A great deal of machinery is dispensed with, by using whip or luff tackles instead of capstans, but in this case, longer time, and more men will be required for the operation.

In heaving or hauling, if all are to do so, the word is *heave* or *haul away*: but if this is to be done by a particular rope only, the rope is to be mentioned previously to giving the word.

In parbuckling, if the gun requires to be muzzled, the word is given *halt* or *avast hauling—breech parbuckle hold on*, or *check the breech*, to be followed by that of, *muzzle the gun*, or *haul on the muzzle parbuckle*—when the gun is brought into a proper position, *halt*, or *avast heaving*, and then, *haul away of all.*

Sometimes instead of muzzling the gun the breech is eased off; in this case the words of command are *halt*, or *avast heaving*, *muzzle parbuckle hold on*, or *check the muzzle*, to be followed by *pinch the breech back*, and when the gun is in a proper position, *haul*, or *heave away of all.*

One Non-commissioned Officer and 12 men, the number assigned for each manœuvre, is the number which is required for making all the necessary and preparatory arrangements, and will be sufficient to perform some of the operations, but in most instances additional men for pulling and hauling will be required. The following are the general duties of the men, which have been so distributed as to render the details of the manœuvres very easy to be remembered, and this general disposition has only been departed from in two or three instances.

When handspikes are employed, 2, 3, 4, 5 have charge of them, and if necessary, 12, 13, 14, 15 when there are more than 12 men.

6, 7 manage the rollers.

8, 9 steady the gun.

10, 11 fix the muzzle and breech ropes; or muzzle and breech tackles, when the gun is moved backwards and forwards; they reeve the main tackle of the sheers.

6, 7, 12, 13 reeve tackles, with the exception of the falls or main tackles of the 24 pounder crane, which are reeved by 2, 3, 4, 5; and those of the sheers which are done by 10, 11.

2, 3 sling the gun, stopper and unstopper the fall, secure leading block to the foot of sheers; fix breech and muzzle guys when these are employed; but when the gun is brought into or taken out of an embrasure, 6, 7 sling it, and fix muzzle and breech guys.

4, 5 except with sheers, secure the leading blocks; make cats paws or fix selvagees.

6, 7 fleet blocks, and hook moveable blocks to selvagees, &c.

8, 9, 10, 11 shift skids.

12, 13 drive posts, and secure standing ends of falls or tackles to them, and attend to the running ends. They all assist in pulling and hauling, when not required for other duties.

If only one luff tackle be used 6, 12, or 7, 13, reeve it according to the side; but though there may be only one fall or main tackle, yet the application of two luff tackles will facilitate the operation; for when it is nearly requisite to shift the luff tackle the men are hauling on, the other luff tackle is to be applied, which will render the stoppering of the fall unnecessary; but then four additional men will be necessary for the operation.

When the gyn is used as sheers, or when sheers are worked with the gyn windlass, which are the simplest and best modes of proceeding in confined situations, as on the parapet, or on the tops of towers, the duties of the men are exactly the same as at the gyn exercise; 2, 3, 4, 5 have the levers; 6, 7, 8, 9 hold on the fall; 10, 11 sling the gun, and fix muzzle, and breech guys when necessary.

But the manœuvres are dissimilar, and in three or four instances what may be done by a particular number in one manœuvre is perhaps done by another number in the next; nor was it possible to obviate this without adding to the number of men for the preparatory part of the operation, and consequently making the exercise more complex.

SECTION 2.

TACKLES.

Tackles are indispensable in the service of the Artillery.

The *fall* is the name given to the rope of which the tackle is composed; that end of it which is fixed to the block is called the *standing part*, or *end*—the other which is pulled, or hauled on by the men, is called the *running part*, or *end*; and the parts which pass from one block to the other is called the *returns of the fall*.

The friction of the pully is very great, particular attention must therefore be paid, that all the turns or *kinks* of a rope be taken out before it is made use of, and it should enter easily into the grooves of the sheaves.

In the operations of Artillery, friction is of use in the gyn, in the capstan, and other similar machines; for by passing the rope two or three times round the axle or windlass, a very small force applied to one end of a rope will be sufficient to resist a very great weight acting on the other end.

The men who take hold of the rope to draw or pull, ought to haul together, and place themselves in a right line, in order that they may not mutually destroy their force.

The most advantageous position for men to pull in, is down a slope, or in a descending direction, for in this case, to the force exerted by the muscles, is to be added to the weight of the man.

Combination of Pullies.

A single fixed pully is called a whip, and in this, the power, on account of the friction must be a little greater than the weight, in order to raise it.

A *whip upon whip* is a greater purchase, and is formed by fixing to the fall of one whip, the block of another whip, one end of the fall of which is attached to a fixed point, and the power to the other end.

These two single blocks will afford the same purchase as a tackle having a single and double block, and with much less friction.

It may be here observed, that, an ascending, or a descending direction of the power, may be changed into a horizontal one, without in any degree altering the proportion between the power and the weight, by passing the running end of the fall through a single block, attached where most convenient. This block is called a *leading* block.

The combination of two single blocks, is called a *gun tackle purchase.*

A *luff tackle,* consists of a double and a single block.

A tackle composed of two double blocks is generally used as a gun tackle for very heavy guns.

If the moveable block of a tackle be strapped with a tail, it is called a *tail* or *jigger block,* and the tackle, a *tail* or *jigger tackle*—a block with a hook strapped to it, and attached to a selvagee, answers the same purpose.

A *runner tackle,* is the same as a luff tackle applied to the end of a large rope, which is called a *runner*, and which is rove through a single block, attached to a fixed point, or to a body that is to be moved or raised; the standing end of the runner being secured to another point.

SECTION 3.

TO GET HEAVY GUNS UP STEEP ASCENTS.

When the ascent is steep, and in fortified places where the space for working in is often confined, it will be necessary to make use of tackles, or of capstans.

In common cases, one Non-commissioned Officer and 12 men will be sufficient to make all the necessary arrangements; any additional men are solely required for pulling and hauling.

1st. *When the gun is dismounted*—it must be parbuckled, for which purpose there will be required.

2 *parbuckles of* 4 *inch rope, each more than double the length of the ascent; when short two or more must be bent together.*

2 *posts.*

1 *maul, or mallet.*

4 *pieces of skidding.*

4 *handspikes and perhaps some tackles, but this must depend upon the strength of the detachment.*

The standing ends of the parbuckles are to be secured to the posts driven in the top of the slope.

As soon as the gun is clear of the two lower skids, they are to be taken up, and placed parallel to and touching the upper ones, and overlapping them about three or four inches.

2, 3, 4, 5 have the handspikes as usual.

8, 9, 10 11 shift the skids.

12, 13 drive the posts for the standing ends of the parbuckles ; 6, 7 pass them round the gun, and return them to 12, 13, who attend to the running ends; a sufficient number of men for hauling are then posted to the parbuckles.

2d. *When the gun is on a carriage*, skidding is unnecessary; but in this case there will be required two 10 or 12 inch single blocks, and two lashings to secure them to the carriage; snatch blocks are most convenient for this purpose; and whenever tackles are applied to the parbuckle or hauling ropes which are attached to the carriage, two selvagees and two or four single lashings.

2, 3 attach the blocks to the axletrees, and together with 4, 5 assist if necessary, with handspikes, to clear the carriage from obstructions; they chock the wheels.

4, 5 when tackles are employed, make cat's paws or fix selvagees.

6, 7 pass the hauling ropes through the blocks at the axletree; when tackles are employed, they fleet the blocks, or overhaul the tackles, and hook them to the selvagees; they together with 12, 13 reeve the tackles.

12. 13 drive the posts, secure the standing ends of the hauling ropes to them, and hand the running ends to 6, 7 who pass them through the blocks which are attached to the carriage, and return them to 12, 13, who attend to the running ends; when tackles are employed, they secure the fixed blocks to the posts, and manage the running ends of the falls.

3d. *When capstans are used,* the following implements will be required.

2 *hauling ropes, or falls of* 4 *inch rope.*

2 *crab capstans with levers.*

2 *lashings of* 4 *inch rope, each* 7 *fathoms long, to secure them to the posts.*

4 *posts.*

2 *mauls, or mallets.*

5 *or six handspikes.*

1 *limber, or any carriage will do.*

4 *single* 12 *inch blocks.*

4 *lashings of* 3 *inch rope, each* 2 *fathoms long.*

1 *hammer.*

2 *or* 4 *wedges or chocks.*

If a preventer be used, an additional fall post, block, and lashing will be required.

The posts to which the standing ends of the falls and the crab capstans are secured, must be solidly fixed in the ground ; should the soil be loose more posts will be required. Small anchors make good hold fasts for capstans.

Two or three spades, with some pick-axes, and a couple of earth rammers, may therefore be necessary.

The limber or carriage is brought to the top of the slope, the hind part towards the slope, and the wheels chocked.

Two posts are driven twenty or twenty five feet distant from the limber, opposite to the shoulders of the axletree ; to these the standing ends of the falls are made fast. Should there be a preventer fall, the post for it is to be driven between them.

Two posts are then driven, or anchors laid down for the capstans ; one of them about fifteen feet distant from the posts already driven, and the other about twenty five or thirty feet, and about four or five feet on each side of the prolongation of the middle line of the limbers.

The two leading blocks are made fast to straps or lashings passed round the upper fellie of the wheels.

The other blocks are made fast to the axletree of the gun carriage, between the cheeks and the naves of the wheels. If there be a preventer block it must be attached to the middle part of the carriage.

When the capstans are worked, the falls bear much on the leading blocks, and the wheels are apt to turn round ; to obviate this, a handspike is passed between the spokes of each wheel, and bearing on the upper surface of the limber ; or they may be secured by guys, attached to the lower part of the wheels, and to the posts for the falls.

The falls are to be arranged as follows :

The standing ends are secured to the posts which have been driven for them ; they are then passed under the axletree of the limber, and carried down the slope ; the ends are passed from below upwards, through the blocks attached to the gun carriage, then led through the leading blocks at the limber, and from thence to the capstans, taking two or three turns round the barrel, and laid out for holding on.

The gun is supposed to have been brought by a party to the bottom of a slope, and ready for the immediate commencement of the operation ; if necessary the limber is brought to the top of the slope by all the men, where it is placed by 6, 7, 8, 9 ; 6, 7 scotch the wheels.

2, 3 attach the blocks to the axletree of the carriage, 4, 5 fix a leading block to the upper fellie of each wheel of the limber, and pass a handspike through the spokes from one wheel to the other.

6, 7 pass the falls through the leading blocks, and the blocks attached to the carriage.

12, 13 drive posts and secure standing ends of falls; receive the running ends from 6, 7, and pass them round the barrels of the capstans, assisted by 10, 11.

The whole of the men fix and arrange the capstans, the odd numbers being told off to one capstan, and the even numbers to the other.

Unless there should be more than twelve men, if during the operation anything is required to be done about the gun carriage or the limber, a sufficient number of men should be taken from the capstans. When there are more than twelve men, the additional men should be posted to the capstan bars.

The gun is also to be brought up the slope limbered up, a limber being taken from another gun. If there be only one capstan, the leading block is to be attached to the middle of the axletree of the limber, so as that the fall be just clear of the underpart of the axletree.

SECTION 4.

Sheers.

The legs or spars for sheers, ought to be from 18 and 20, to any number of feet in length, and from 5 to 10 and 12 inches in diameter at their butt end, both of these dimensions depending on the nature of the operation to be performed ; the longer the spars are, the greater will be the effect produced.

Sheers erected on the sea-beach must always be of a large size, and placed so far in the water, that a boat with a heavy gun in it can float under them.

Small sheers in such cases can only be used when the water is smooth and there is no swell.

According to the nature of the operation, sheers when raised may be perpendicular, or they may be made to incline forward or backward.

Should it be to mount a gun, they may be perfectly upright; but should they be employed to raise guns on the ramparts of a fortification, they must, if possible, have such an inclination forwards, as that when the gun is being raised, it may not rub against the escarp.

The greater the inclination of the sheers, the greater will be the strain on the guy which supports the top, and a preventer guy as a precautionary measure may sometimes be advisable.

By removing its prypole the gyn can be used as sheers, but, in this case, a piece of wood, about 5, or 6 inches long, similar in every respect to the top of the prypole, must be placed in the collar or shackle, and the bolt passed through it and the cheeks. When the operation of placing guns on the parapet can be performed by the gyn used as sheers, it ought to be done, though it is much more tedious than when a crab capstan is employed; it is particularly useful on the top of a tower, where there is always considerable, and often great difficulty in leading the fall of the tackle from the foot of the sheers to the capstan.

When the gyn is used as sheers, the levers employed ought to be similar to those of a sling cart, with a whip at the small ends; this obviates the necessity of the men mounting on the windlass, which is supposed to have a pawl.

The above application of the gyn is attended with this disadvantage, that the lower cross bar prevents the gun from being brought breech foremost into the work, and therefore, the gun, when raised, must be laid in a direction parallel to a line drawn from the foot of one cheek to that of the other and made. to touch them, in order to bring the weight as far inside as possible from the edge of the parapet. To obviate this inconvenience. the lower cross bar may be removed, and to prevent the cheeks from opening out, a rope may be passed round the cheeks from one to the other, as close under the windlass as can be done without interfering with the working of the levers.

When they are long enough for the operation, the cheeks of the gyn without the windlass, or two prypoles, may be used in every respect as sheers, and will save a great deal of lashing at top.

When there is no capstan, and circumstances require that the weight be raised higher than can be done by the gyn used as sheers; the sheers composed of spars of a sufficient length are to be put up as usual. and in order that the gun may be raised with fewer men, two or three strong spars are to be lashed horizontally across the cheeks of the sheers, and to these the cheeks of the gyn are to be lashed, the tackle fall led to the windlass, and the gyn worked. In this case, the lower cross bar of the gyn may be removed; this is the best way of proceeding when the gun is to be placed on the top of a tower, where, in general, there is not room for a crab capstan.

In order to prevent the feet of the sheers or of the gyn from sinking, when on the parapet, they ought to be made to rest on trucks or on slabs of wood, having an excavation in them for the reception of the feet; and to prevent the feet from slipping, they ought to be secured by ropes to posts driven in a proper direction.

The greatest attention is to be paid, that, the posts to which the guys, crab capstan, &c. are made fast, be properly, and very solidly fixed and driven into the ground. When the soil is light and soft, additional posts must be used.

The gun may be raised either by the men walking away with the fall without stopping, or it may be raised hand over hand; when there are not men enough, a crab capstan may be used; or a whip, or a luff tackle may be applied to the fall.

When the gun is lowered, a turn or two may be taken with the fall round a post, very solidly fixed in the ground, and the fall eased off or slacked off.

The following are the stores and implements required in ordinary cases, recollecting that, the length of the guys and runners must depend on the distance from the sheers of the posts to which they are to be made fast.

2 *Spars of* 35 *or* 40 *feet long.*

1 *Lashing for top of sheers,* 2 *and a half inch rope,* 7 *fathoms long.*

1 *Sling for upper block or tackle fall,* 5 *inch rope,* 3 *fathoms long.*

4 *Lashings for securing feet of sheers,* 3 *and a half inch rope, each* 3 *fathoms long.*

4 *Posts for these lashings.*

1 Back ruuner guy, 4 inch rope, 30 fathoms.

1 Post for ditto.

1-12 Inch single block for ditto.

1 Lashing for ditto, 2 and a half inch rope, 2 fathoms.

1-8 Inch double } Block for luff tackle for ditto.
1-8 do. single }

1 Fall for ditto, 2 and a half inch rope, 45 fathoms.

1 Lashing for upper block, 2 and a half inch rope, 2 fathoms.

1 Fore runner guy similar to the above.

If preventer guys are used, 2 or 4 will be required, according to circumstauces, together with Posts.

1 Gyn tackle complete, with fall of a proper length of 3 and a half inch rope.

1-12 Inch leading block for ditto, a snatch block is most convenient.

1 Lashing for ditto, 2 and a half inch, 3 fathoms.

1 Gasket for stoppering the fall, 3 and a half inch rope, 2 fathoms long.

1-3½ inch rope, 2½ fathoms, for slinging the gun.

Spun yarn for mousing and seizing, 6 fathoms.

If the weight raised be very considerable, a single brass sheaved gyn additional block may be fixed to the top of the sheers, and the triple block hooked to the gun sling.

If the sheers be erected over an embrasure, there will be required 14 platform planks to cover the embrasure to enable the men to move about.

1 crab capstan with bars.

1 post for ditto, an old anchor is best.

1 lashing for ditto, 4 inch rope, 7 fathoms.

2 mallets.

3 spades, or mamoties.

3 pickaxes.

6 handspikes.

If instead of the capstan, tackles be used, there will be required, 1 luff tackle complete, fall 2½ inch rope, 45 fathoms.

1 selvagee.

1 post.

1 *lashing, 2½ inch, 2 fathoms,*

By using two luff tackles the work can go on without interruption.

The number of men necessary for the operation must always depend on situation and circumstances. When the ground is level, twelve men and a non-commissioned officer will be sufficient to prepare every thing, and to raise the largest sheers which can be required in the artillery service; generally speaking their duties will be as follows:

2, 3 drive the posts for the foot ropes, and secure the feet to them with lashings; they assist to raise the top of the sheers, and lash the leading block to the foot; they fix the gaskets and stopper the fall; sling and unsling the gun.

4, 5 lash the spars together; fix the fore and back guys or runner, and block at top; if there be no spare men, they assist 2, 3 in raising the top of the sheers.

6, 7 assist 4, 5 in lashing the top of the sheers; place the sling for the main tackle across the crutch; if they are raised by the fore guy, they haul on it, and, if by the rear guy, they lift at the top of the sheers.

8, 9 drive the posts for, and prepare, the front guy; if raised by this guy, they haul on it; but if by the rear guy, they lift at the top of the sheers; they attend the fore guy; but if the ditch, or any obstacle intervene between the sheers and the post for the fore guy, as would be the case when erected on a parapet, two men must be detailed for this purpose alone, quite unconnected with those who work the sheers.

10, 11 reeve the tackle, hook the upper block to the sheers; lift at the top of the sheers, if raised by the fore guy, but, if by the back guy, they man it.

12, 13 drive the post for the back guy; and if the sheers be raised by that guy, they haul on it, and attend to it; if raised by the fore guy, they lift at the top of the sheers; they attend the rear guy. When the men who lift the top of the sheers can no longer do so with effect, they will break off and man the guy by which the sheers are being raised.

The sheers may be raised either by the fore or the back guy, according to circumstances. When every thing is ready *raise the sheers*—when they are in the right position *halt*—*make fast the guys*—8, 9—12, 13 do this.

It is only at the first that the great effort is required; after the top has been raised seven or eight feet from the ground, the operation is easy; but should the sheers be large, twelve men will have great difficulty to raise them without a crab capstan or a luff tackle, or a whip upon whip.

Machines for Mounting and dismounting continued.

These implements are also required for raising the gun.

When the sheers are raised by the capstan, the first six, or the last six numbers, according as it is raised by the back or by the fore guy, place it and work it; the others lift the top of the sheers.

When the gun is raised by the capstan, all the numbers except 2, 3 man it; 2, 3 stopper the fall; but should their services be required at the capstan, 1 stoppers the fall.

With a luff tackle or whip upon whip, 6, 7, 12, 13 reeve the tackles; 4, 5 make cats paws or fix selvagees; 6, 7 fleet the blocks, or overhaul tackles, or hook them to selvagees; 12, 13 secure the fixed blocks and attend to the falls; 1 stoppers the fall of the main tackle; the whole of the men are posted to the tackles.

When sheers are worked with the gyn windlass, the gyn is put together without the prypole. 2, 3, 4, 5 lash the upper spar, and 6, 7, 8, 9 the lower spar, across the cheeks or legs of the sheers; should there be a third spar, it is to be lashed by 10, 11, 12, 13.

They all raise the gyn, and secure its cheeks to their respective spars, each on his own side. 2, 3, 4, 5 work the levers; 6, 7, 8, 9 hold on the fall; 10, 11 sling the gun, as at the gyn exercise.

When the sheers are struck, if the rear guy be eased off, it is to be done by 10, 11, 12, 13; if the fore guy, by 6, 7, 8, 9; all the other men, except the four so employed, receive the top of the sheers.

When the gyn is used as sheers, or when the sheers are worked with the gyn windlass, the operation is more tedious than with the crab capstan, or with luff tackles; but this mode of proceeding has this advantage, that it is performed with fewer men; four men can with ease raise the gun, and three or four hold on the fall.

SECTION 5.

TO PASS A GUN FROM ITS CARRIAGE INTO AN EMBRASURE, EITHER CASEMATED OR NOT CASEMATED, AND LOWER IT FROM THENCE, OR FROM THE RAMPART, INTO THE DITCH; ALSO TO RAISE IT FROM THE DITCH, AND PASS IT TO THE RAMPART, OR THROUGH AN EMBRASURE, ON TO ITS CARRIAGE.

When the sole of the embrasure is of masonry, and has no more than the usual inclination, no planks will be required for the operation; but when it is of earth, they are necessary, in order to facilitate the progress of the rollers, and to prevent the sole from being damaged by the weight of the gun.

When the sole of the embrasure happens to have a great slope, the gun would be apt to run out of itself, or its motion be very irregular. In this case it will be necessary to use planks, on which the gun is made to move on rollers; and in order to make the planks horizontal, or nearly so, their outer ends must be raised, by placing pieces of short skidding under them, the inward ends resting on the sill of the embrasure; and when the distance between the sill and the outward ends of the planks is more than six or seven feet, they must be supported between these two points.

Instead of a common rope, a muzzle tackle and a breech tackle should always be employed, as their action is uniform; whereas, that of the rope is often by jerks, which are unavoidable.

The fixed block of the muzzle tackle to be secured to a lever or spar of a proper length, laid across the mouth of the embrasure; or when the embrasure is a casemated one, a rope, one end of which is attached to a post on the rampart or parapet, may be let down over the parapet, and the muzzle tackle made fast to the other end.

The breech tackle is to be secured to a post, or other holdfast in rear of the carriage.

Besides the sheers, or gyn used as sheers, as stated in Section 4, page 78, the following implements and stores will be required for this particular operation.

4 *guys, for breech and muzzle,* 2½ *inch rope, each in length more than the height the gun is to be raised or lowered.*

1 *gun tackle for muzzle fall,* 2½ *inch,* 8 *fathoms.*

1 *muzzle lashing for ditto,* 2½ *inch,* 2 *fathoms.*

1 *lever or spar to go across the mouth of the embrasure, or a post driven in the parapet, and a rope let down from above.*

1 *lashing for securing the fixed block to the spar,* 2½ *inch rope,* 1 *fathom.*

1 *luff tackle for breech fall* 2½ *inch,* 23 *fathoms.*

1 *post for ditto.*

2 *lashings for ditto,* 2½ *inch, each* 1 *fathom.*

1 *mallet.*

2 2½ *or* 3 *inch planks of a proper length for rollers to move on, with pieces of skidding, if necessary, to make them horizontal; the height of their upper surface, with respect to the height of the carriage, must depend on the diameter of the roller.*

2 *rollers each* 20 *inches long.*

2 *wedges for chocking rollers.*

4 *chocks for the wheels or trucks of the gun carriage.*

6 *handspikes.*

In ordinary circumstances, one non-commissioned officer and twelve men, will be sufficient for this operation with a 24 pdr. they will previously have erected the sheers. There must also be four or more men in the ditch for receiving and unslinging the gun, and also for preparing the skidding and slinging the gun when it is to be raised, two of whom will have charge of the breech and muzzle guys.

If the gun is to be lowered from the rampart, it is supposed to have been raised out of its carriage, as in Sec. 3, page 25, and it may then be pinched into the embrasure, with one roller under the chase; should the sill be damaged, a short plank may be required, to be laid on the breast transom of the carriage and the neck of the embrasure, on which the roller is to move. If the trail of the carriage be raised by placing quoins or wedges under the rear trucks, the gun will be more easily transferred into the embrasure.

6, 7, 8, 9 lay the planks in the embrasure, and make the necessary arrangements.

6, 7 pass a lashing round the neck of the piece, and hook the moveable block of the muzzle tackle to it, they also hook the other block to a lashing attached to a lever held across the mouth of the embrasure by 8, 9, when the embrasure is an open one; but when it is casemated, to a rope let down from the rampart by 10, 11.

6, 7 do all the work in the embrasure, attend to the Rollers, sling and unsling the gun, and hook the tackle; but should they require any assistance to alter the position of the gun when in the embrasure, or to steady it, or to raise it to allow of the rollers being put under it or shifted backwards or forwards, it is to be done by 8, 9; 12 secures the moveable block of the breech tackle by a lashing to a breeching loop, 13 drives the post, and attaches the fixed block to it.

In the first instance, the muzzle tackle must be manned by 8, 9, 10, 11, 12; the breech tackle is eased off by 13. *Heave or pinch the gun forward*—the handspike men 2, 3, 4, 5, act accordingly, the muzzle tackle is hauled on, and the operation proceeds until the gun be fairly in the embrasure; 6, 7 applying and shifting the rollers according to circumstances; when the gun is in the embrasure, 2, 3, 4, 5, can assist at the muzzle tackle. As the gun advances, it may be necessary to shift the muzzle tackle nearer to the trunnions, which is to be done by 6, 7.

When the gun has been carried so far out, that the middle of the chase is just within the mouth of the embrasure, *halt, breech tackle, hold on, or belay breech tackle,* or wedges may be applied to the rollers; *ease off muzzle tackle.*

The gun is now ready for slinging to the main tackle of the sheers, and the word *sling the gun* is given. 6, 7 pass the sling round the gun behind the trunnions, *hook the tackle, man the capstan,* the capstan must be manned by 2, 3, 4, 5, 8, 9, 10, 11; 12, 13 holding on.

Heave away, as the tackle acts on the gun, it will be gradually raised, and launch itself muzzle foremost more and more out of the embrasure, until it be fairly suspended outside; and as 13 is employed holding on at the capstan, 9 eases off the breech tackle, which is to be cast off by 6, 7, who will take care that the rollers do not fall into the ditch; they attend to and manage the breech and muzzle guys, which they fasten.

Ease off the fall, 12 eases off the fall, and the gun is lowered into the ditch, he is to be assisted by 13.

To pass a gun from the mouth of an embrasure on to its carriage, the same number of men and of implements will be required, with the exception of the muzzle tackle; the men perform the same duties.

When the gun has been raised and hangs suspended at the mouth of the embrasure, the breech tackle is made fast by 6, 7; 8, 9, 10, 11, 12, 13 man it, and bowse on it in proportion as the gun is allowed to descend on a roller, and has entered the embrasure breech foremost; when the middle of the chase is within the mouth of it, *hold on breech tackle, unsling the gun,* to be done by 6, 7; *haul away on breech tackle,* and the gun is made to move along until it is fairly on the carriage; 2, 3, 4, 5 having quitted the capstan.

The carriage must have been previously run up close to the interior slope, and the wheels chocked. *Cast off breech tackle*—the gun is now ready to be lowered into its carriage.

When in raising a gun, it has been brought opposite to the mouth of the embrasure, or where it is to be placed on the parapet, it is a little higher than the exterior crest of it; the top of the spars must be hauled in until the tackle fall be, if possible, vertical; 10, 11, 12, 13 assisted if necessary, by 8, 9, do this. On lowering a gun, and at the commencement of the operation, the tackle should also be vertical, easing off as much as may be necessary as the gun is descending; 10, 11, 12, 13 ease off, assisted by 8, 9.

When there is no crab capstan, a luff tackle must be applied to the fall; 6, 7, 12, 13 reeve the tackle; 4, 5 fix selvagees; 6, 7 fleet blocks and hook them to the selvagees; 12, 13 secure the fixed block to the post, and attend to the fall; 2, 3 stopper the fall of the main tackle, but when they are required to man the luff tackle, 1 will stopper the fall.

SECTION 6.

TO ERECT SHEERS ON THE TOP OF A TOWER.

All towers should have rings, or projections, built into the parapet or other part of them; or holes in various places on the outside, into which pieces of timber of a proper scantling could be inserted, to which the guys &c. of the sheers, can be made fast.

If the lower story of the tower be loop holed, the loop holes offer great facility for this purpose. A strong rope doubled, or trebled, if thought necessary is passed round two or three handspikes or a piece of wood laid across their opening inside, and led from thence to the top of the parapet, at which place the back guy or guys will be attached to it. The door-way of the tower would serve for the same purpose. The fore guys are to be secured to posts, or to other proper places, outside of the tower. It is necessary that the greatest attention be paid to place properly the feet of the sheers; frame work ought to be made for them; local circumstances vary so much, that no precise rule can be laid down on this head; however the platform or frame work should be so fixed, as to prevent any part of it from giving way to the right or left; the feet of the sheers may also be secured from opening out, by taking several turns from one to the other with a rope.

As towers are of masonry, the parapet is never more than 8 or 9 feet thick, and frequently when the sheers are of a large size, the feet can be set on the terreplein; in this case they must be placed so far inwards, that, when the sheers are inclined forward so as to make their head project beyond, or be just clear of the escarp, the legs do not bear on, or touch, the inner crest of the parapet.

Few towers are so large as to admit of a crab capstan being used inside on the terreplein.

In which case it must be placed outside on the ground; this however requires additional blocks, through which the fall is to pass, and consequently a great increase of friction. But, whenever the capstan can be used, the operation will be much more expeditious than by any other mode, for the gun can be placed on its carriage at once by hauling in the head of the sheers.

The gyn can always be used as sheers; or what is better, the cheeks of the gyn, can be fixed to the spars of the sheers, and in both cases worked with its own windlass; the lower bar of the gyn to be taken out and the gun, breech foremost, passed under the windlass into the work.

A luff tackle can always be applied to the fall, which will be found the most convenient way; by this means fourteen or sixteen men can raise a 24 Pr. See Article 17, for a mode of getting guns up the escarp of works, or on the tops of towers.

SECTION 7.

TO LAND HEAVY GUNS DISMOUNTED FROM BOATS OR RAFTS BY PARBUCKLING, AND ALSO TO EMBARK THEM.

In the embarkation or disembarkation of heavy guns dismounted, in or from boats, or rafts, by means of skids, the greatest attention must be paid, that the ends of the skids do not rest on the gunwale, but at a proper distance within the boat; by which means the bearing will be thrown, so much inwards, that when the weight of the gun acts on the boat, the latter will not heel too much, and thus the gunwale not be forced under water, or the boat greatly strained.

In embarking a gun, the boat must be kept at such a distance from the shore, that it do not take the ground when the gun is on board, or that it just barely touch the ground. In disembarking the boat ought to be brought as close to the shore as possible.

The above observations only apply to smooth water.

When there is a swell, parbuckling is not to be attempted, and recourse must be had to sheers.

The gun may be parbuckled or embarked.

1st. *From a place considerably higher than the boat or raft.*

2d. *From a place on the same level; these two are the most advantageous cases, for the gun descends, one inclined plane only; or*

3d. *From a place which is lower, as the sea beach.*

In the first case, the skids may be made to bear on the bottom of the boat, and the gun placed there by removing one or two of the thwarts; dunnage will however be required, consisting of some 3 inch or other planks placed fore and aft, on which two pieces of short skidding are to be laid for the gun to rest on. The ends of the par-buckling skids should bear on the dunnage, and immediately over a rib.

A raft has the advantage over a boat, in that its upper surface is quite flush, whereas the gunwale of a boat is higher than the part of it on which the gun is to rest, and consequently, as in the 3d. case, the gun has to mount (first) on the skids on one side, and descend on the skids on the other side, and two sets of parbuckles are required; indeed, they are necessary where there is a current, or a gentle surf, which may cause the boat to raise and fall.

In embarking, the boat parbuckles are for parbuckling the gun up the embarking skids, and the shore ones for checking it, or easing it from the skids to its place on the thwarts.

In disembarking, the shore parbuckles are for parbuckling the gun from the boat to the disembarking skids, the gun is checked by the boat parbuckles.

The boat ends of the embarking skids, must be higher than, and not touch the gunwale; they are to be placed directly over the thwarts, and to rest on planks or pieces of timber laid over the thwarts; or when local circumstances admit of it, on the thwarts themselves, to which they ought to be lashed, and which must be propped in the middle, as the gun is in general to rest on them.

The boat must be kept steady and close to the shore by ropes at the head and stern, secured to posts which are better than men with boat hooks; there is occasionally a great strain on these ropes, as the ends of the skids have a tendency to force the boat out.

The boat ought also be steadied by anchors or grapnels let go to seaward.

The carriage is embarked after the gun, being made to slide along the skids. If a garrison carriage, the skids must be brought closer together. If a travelling one, it may be shoved along, side foremost; or, if breast foremost, each axle-tree arm must rest on a skid, and a short plank or lever lashed across the cheeks at the trail, the ends resting on the skids.

The following will be in general required.

8 *handspikes.*

2 *long skids, and sometimes more, according to circumstances; they ought to have eye-bolts or holes ought to be bored near their ends, so that a rope could be passed through them, and the skids then secured to a thwart; each about* 14 *or* 16 *feet long, and* 8 *inches by* 6.

4 *shorter skids.*

3 *or* 4 *planks, or pieces of wood, as the case may require, to lay on the thwarts, on which the boat ends of the skids are to rest, and thus keep them clear of the gunwale.*

4 quoins or wedges, to facilitate the ascent and descent of the gun on and from the skids.

5 or 6 small wedges or scotches.

4 parbuckles, 3½ inch, each about 7 fathoms long.

4 posts.

1 mallet.

2 pieces of 2½ inch rope, each 6 fathoms, for head and stern ropes.

2 skid lashings, 2⅓ inch rope, each 2 fathoms.

2 small anchors, or one anchor and a grapnel.

2 cables, 3 inch rope, each 10 fathoms; and, according to local circumstances, a greater or less number of these articles may be required.

The number of men required for the operation must vary according to circumstances: but two non-commissioned officers and fourteen men will be required to arrange every thing, and in some instances may embark and disembark the gun; there must however be a sufficient number for pulling and hauling; the men are divided into two parties, or one non-commissioned officer and eight men for the shore duties, and one non-commissioned officer and six men for the duties in the boat or raft.

The general duties of the shore party will be nearly as follows.

2, 3, 4, 5 have the handspikes; lay the shore ends of the skids; skid the gun on them; pass the parbuckles round the gun, and haul on the parbuckles or ease them off when not employed with the handspikes.

6, 7 drive the posts for the parbuckles, and make their standing ends fast to them; hand the running ends to 2, 3, 4, 5, who, after having passed them round the gun, return them to 6, 7, who will coil up or ease off the ends as may be required.

If the gun is to be disembarked, the parbuckles are to be handed to 2, 3, 4, 5 of the boat party.

8, 9 drive the posts for the head and stern fasts or painters of the boat, make them fast, and haul in or slack off as occasion may require.

The duties of the party in the boat will be generally as follow.

6, 7 have charge of the anchors or grapnels, and having let them go in proper places, will veer out cable, and allow the boat to be brought to the shore; when the boat is secured to the shore, they, assisted by the Nos. in the boat, tighten the cables and make them fast; they then assist in the other operations.

Four handspikes are to be in the boat, which, when required, are to be manned by 2, 3, 4, 5, who arrange and lay the boat ends of the skids, and secure them to the thwarts.

When a second set of parbuckles, or boat parbuckles, are required, 6, 7 make fast the standing ends to the thwarts close to the off gunwale, and if the gun is to be embarked, hand the running ends to 2, 3, 4, 5, of the shore party, who pass them round the gun, and return them to 6, 7, who will coil them properly in the boat; but if the gun is to be disembarked, the parbuckles, are to be handed to 2, 3, 4, 5 of the boat party—2, 3 of one party or the other, according as the gun is to be embarked or disembarked, will, whilst performing the above, be careful that the parbuckles do not cross or ride on one another.

Any additional men necessary for the operation, will be for the purpose of pulling and hauling, and do not need to be detailed for any particular duty; they will assist whenever required.

Embarking and disembarking heavy guns, in and from boats by parbuckling, demands great care and attention.

In lowering, for embarkation, heavy guns by the parbuckle down very steep places, where a considerable number of men would be required to hold on, the following plan may be adopted. Four strong posts are to be driven, two for the breech parbuckle, and two for that of the chase; a large roller or round piece of timber is to be laid on the ground, behind and across each two posts, which are about two feet from each other; two or three turns are to be taken with the running ends of the parbuckles round the rollers, and are eased off as at a windlass.

SECTION 8.

TO LAND FROM, OR TO EMBARK IN RAFTS, HEAVY GUNS MOUNTED.

This is a very simple and easy operation: The gun is embarked or disembarked by means of two skids or railways, having a batten on one side of them, by which the wheels are kept in a proper direction, and cannot slip off. These railways communicate with similar, but longer ones, which are laid from one end of the raft to the other, and in continuation of them.

The embarking railways are kept at the required distance from each other by means of transom bolts or two bars, and they are put together and separated in a few minutes.

Stout ropes may be substituted for the bars, with an overhand knot for the shoulder, and the skids kept apart by two wooden transoms ; but where there is a current the iron bars will save much trouble.

When skids or planks of the above description cannot be had, the common pontoon balks and chesses may be used for the same purpose, covering the whole length of the balks with a double row of chesses, and racking down the sides, so as to form a platform or ramp ; this is called a *brow*.

In a raft which is to go several times backwards and forwards, the embarking skids will be found much more convenient, and more expeditiously prepared than the *brow*, or platform of balks and chesses.

The raft ends of the embarking skids, or of the above platform, must always be clear of the inshore gunwale of the raft, and rest at a proper distance from it, in order that the gunwale may not be forced under water, or the raft heel too much whilst the gun is being embarked.

Should the superstructure of the raft be of pontoon chesses, or thin planks, the raft ends of the embarking skids should never bear directly on it, but on an additional chess, or a slab of wood, or piece of stout plank ; without this precaution a heavy gun might cause the ends of the skids to break or force their way through the chess. The raft should have a platform of nearly 28 feet long, which will carry a 24 pounder on a travelling carriage limbered up.

In all situations, wherever it is possible to be done, the point of support on shore for the embarking skids should be as high as the superstructure of the raft, when there is not any thing upon it.

The following will in general be the implements and stores required for this operation.

2 *embarking or railway skids or planks, each about* 12 *or* 14 *or more feet long,* 1 *foot broad, and* 5 *inches thick (if of fir), having a longitudinal batten not exceeding* 3 *inches in width, with two bolts and keys; if the skids be of oak,* 3 *inch plank will be sufficient.*

2 *or* 4 *railway planks,* 3 *inches thick, for the superstructure of the raft, so as to make up two lengths, each of* 20 *or* 24 *feet, also with battens, with these planks a thin superstructure will do for the raft.*

4 *quoins or wedges, each about two feet long, and six inches in extreme thickness, according to the thickness of the embarking skids, to facilitate the ascent and descent of the carriage on and from the embarking skids.*

4 *small wedges or scotches for chocking the wheels of the carriage when embarked.*

1 *gang board for the men who hold up the pole of the limber, a pontoon chess will do.*

2 *posts.*

1 *mallet.*

2 *pair of heavy dragropes.*

5 *handspikes with the gun.*

The raft is supposed to be completely equipped.

There will be required two non-commissioned officers and twelve men to make all the necessary arrangements, half on board of the raft and half on shore, each party being numbered separately; besides a sufficient number of men for embarking and disembarking the gun.

One of the parties, as the case may be, pass the embarking skids from the shore to the raft, or from the raft to the shore, where they are to be received by the other party. In putting them together, 2, 3, 4, 5 hold up and manage the skids, whilst 6, 7 insert the transom bolts and key them.

2, 3 of both parties, place an inverted chess or plank on the shore, and another on the raft, for the ends of the embarking skids to bear on, they also lay the wedges, for facilitating the ascent and descent of the carriage on and from the skids .

4, 5 of each party, place the gang board, or the chess, which is substituted for it.

6, 7 of the shore party, drive the posts for the head and stern fasts of the raft, and make fast the painters.

6, 7 of the raft party, have charge of the anchors and grapnels, and proceed as directed with the boat in parbuckling. See section 7, page 89.

Every thing being ready for embarkation, the dragropes hooked by the shore party, viz. 4, 5 for hauling, and 2, 3 for holding on, 6, 7 being at the limber pole, the gun and carriage having been placed in a favorable position to be moved on the skids, and the dragropes properly manned ; the men told off for the purpose will haul away, whilst some on shore will as long as they can act, shove the gun forward. When it begins to move down the skids they will hold on, and ease off gently until the gun is embarked, and placed properly on the raft ; 2, 3, 4, 5 of the raft party, assisting if necessary, with handspikes. When from the smallness of the raft, it is necessary that the gun be taken on board unlimbered ; they must raise and lift the trail over the bolts of the embarking skids, or a pontoon chess or two spare balks must be laid from the raft to the shore, over the iron transoms of the embarking skids.

When a brow of pontoon balks and chesses is used, the whole of the men will assist in laying it.

When the raft cannot be brought near the shore, and causes the bearing of the embarking skids to be great, intermediate supports, consisting of low trestles or pieces of wood, ought to be placed under the skids.

The gun is also disembarked, limbered up, and the operation is exactly the converse of the preceding.

The disembarking skids are handed from the party in the raft to the party on shore. When everything is properly arranged, the same numbers as before lift the pole, hook the dragropes, &c. &c.

SECTION 9.

TO LAND AND TO EMBARK FIELD GUNS MOUNTED, FROM AND IN BOATS, EITHER IN FACE OF AN ENEMY OR OTHERWISE.

This is a most essential operation, and the field artillery attached to the division of troops which is first to disembark should always be landed in the mode hereafter stated.

Any boat if large enough can be fitted for this purpose.

Two railway planks are required for the boat, exactly similar to those of the raft, (see section 8, page 93) together with two embarking skids or planks, the boat ends of which bear on a transverse beam of timber, placed on the gunwales a little within the bow, and at right angles to the keel; the communication between these and the railway planks is maintained by two short railways, one of the ends of each of which rests on the transverse beam, and the other on the planks in the boat.

The boat is generally towed by smaller ones, and is also moved along by paddles.

On actual service, the embarking skids are always laid out and taken on board the boat's crew, who also assist in disembarking the gun.

The muzzle of the gun when in the boat generally points forward or to the head of the boat, as it is most conveniently embarked limber foremost.

The limber must always accompany the gun, by which means the latter travels with greater facility, and the ammunition is more easily and conveniently carried.

Two men of the boat's crew, one on each of the stern sheets, with a boat hook, must keep the head of the boat to the shore; and it will also be necessary to have a rope on each side of the bow, to keep the boat steady.

In passing from the embarking skids to the railway planks, or from the latter to the embarking skids, the gun is first made to ascend and then to descend. The men, therefore, with their dragropes, must be prepared to haul and to hold on according to circumstances.

The following are the implements or stores required for the operation.

2 railway planks about 18 or 20 feet long.

2 embarking, skids or planks, 12 or 14 feet long.

2 short railway planks, to keep up the communication between the embarking skids, and the railway planks.

1 beam or broad piece of timber for laying on the gunwales of the boat, a little within the bow.

1 gang board from the bow to the shore.

4 wedges to chock the wheels when the gun is embarked.

The railway planks and embarking skids to be fitted with lashings to secure them to the boat.

The boat is fitted with painters, anchors, cables, paddles, &c.

The gun is supposed to be completely equipped for service.

The usual detachment of nine men is required for the service of the gun.

On the word *prepare to disembark the gun*, 2, 3, 4, 5 unscotch all the wheels with the exception of the front part of the limber wheels; they then stretch out the gun dragropes and man them; they are hooked to the axletree.

6, 7 man the limber dragropes, which are hooked to the outer trace loops of the splinter bar, and are for holding on when the gun descends; they will shove the gun forward, when necessary, at the wheels.

8, 9 are at the pole.

In these duties the boat's crew assist.

The boat's crew lay out, and take on board the embarking skids; keep the head of the boat to the shore, &c. &c.

In embarking, the same numbers manage the dragropes, with this difference, that the limber dragrope men haul the gun up, and the gun dragrope men shove it forward or hold on as circumstances may require; 2, 3, 4, 5 chock the wheels.

The gun detachment is posted in the boat as follows.

2, 3 in front of the gun.

4, 5 between the gun and limber.

6, 7, 8, 9, and 1 in the stern sheets, all of them sitting down.

SECTION 10.

TO FORM A TEMPORARY CRANE WITH TWO FIELD LIMBERS FOR EMBARKING AND DISEMBARKING GUNS OF A PROPORTIONATE WEIGHT FROM A WHARF, OR FROM THE BANK OF A RIVER WHICH IS VERY STEEP AND PRECIPITOUS.

The shafts of both limbers are to be shifted for single draught.

A limber with the boxes off is then to be backed within a few feet of the edge of the bank or wharf.

The other limber is to have the ammunition boxes on; its shafts are to be laid on the axletree of the first limber, and so far over it, that the points may project about a foot beyond the hind part of the wheels; they are to be lashed to the first limber by the lashings of its ammunition boxes, which have been removed.

The shafts of the first or under limber, are to be secured to the limber hook of the upper one, by a dragrope, or lashing rope; and the shafts of both limbers are to be lashed together between the splinter bars.

Two traversing handspikes are then to be laid close together, across the shafts of the upper limber, just clear of the hind part of the wheels; the thick end of a handspike on each shaft; they are lashed to the shafts.

Two leading blocks are then to be hooked between the handspikes, to a part of the rope which secures the handspikes to the shafts; the blocks are to be about a foot on the outside of each shaft.

The foregoing arrangement with one pair of shafts will be sufficient for a 6 pounder gun or 12 pounder howitzer; when a 9 pounder gun or 24 pounder howitzer is to be embarked, two pair of shafts will be required and three handspikes.

When two pair of shafts are used, the shafts of the under limber must be taken off, and placed on the inside of the shafts of the upper limber, and close to them, and secured to each other, and to the axletree of the under limber as before.

If three pair of shafts be used, the third pair must be placed between the other two and above them; or they may be placed outside of the limber shafts.

In order to prevent the rear limber from tilting up, in consequence of the increase of weight in the embarkation and disembarkation of a 9 pounder gun or of a 24 pounder howitzer, it may be advisable to place one or two boxes of the waggon body on this limber

Two posts are to be driven at a proper distance from the bank, and about two feet on each side of the middle or axis of the limber.

When the gun is on its carriage, the standing end of each fall is to be fixed to these posts, and the other end passed under the limber, and through the blocks which are to be attached to the axletree of the carriage; then passed from the front to the rear, through the leading blocks, which are fixed to the shafts, and led over the limbers, passing between the ammunition boxes and the wheels.

When the gun is dismounted, the arrangement is exactly similar, with the exception of the mode of securing the standing ends of the falls, which are laid over the handspikes, and passed under the splinter bar and under the axletree of the rear limber, and made fast to the limber hook. In this case the shafts bear the whole weight of the gun, which is to be slung in two places at proportionate distances from the centre of gravity.

If the gun on its carriage is to be lowered or embarked, it is to be backed trail foremost to the edge of the bank, and the tackles hooked. The crane is then run towards the edge till the leading blocks project sufficiently, when the wheels are to be locked with dragropes and the gun lowered.

In disembarking, the crane is run to the edge of the bank and the tackles hooked; when the gun is brought close to the crane, the latter is run forward.

The following stores will be required.

2 limbers, being the gun limber and the limber of its ammunition waggon.

4 single 6½ inch blocks.

2 falls of 2½ inch rope of a sufficient length.

4 *lashings of* $1\frac{1}{2}$ *inch rope, each 2 fathoms, viz. 2 for lashing the shafts together between their splinter bars, and 2 for lashing the traversing handspike across the shafts, and also the 2 leading blocks.*

3 *or* 4 *picket posts.*

1 *wood mallet.*

1 *or* 2 *dragropes or ropes of a sufficient length for guys to be attached to the trail of the carriage, or to the breech and muzzle of a dismounted gun.*

2 *lashings of* $2\frac{1}{2}$ *inch rope, each 2 fathoms, for slinging a dismounted gun.*

One non-commissioned officer and twelve men will be sufficient for putting the crane together, and making the necessary preparations, to which must be added four men in the raft or boat.

The gun is backed towards the bank and unlimbered, the trail to be brought towards the bank; 2, 3 fix guy ropes to the limbering loop.

4, 5, 6, 7 unlash the limber boxes and place them on each side; 2, 3 shift the shafts for single draught.

8, 9, 10, 11 bring the waggon parallel to the gun, unlimber it, shift the shafts of its limber for single draught, and lay the shafts over the gun limber.

2, 3 lash the shafts of the waggon limber to the axletree of the gun limber, and hook the blocks to the gun axletree.

4, 5 lash the handspikes across the shafts, and attach the leading blocks to them.

6, 7 lash the shafts together between the splinter bars, and, when ordered, lash the wheels together with two dragropes.

8, 9 lash the shafts of the under limber to the limber hook of the upper one.

10, 11 prepare the falls, the standing ends of which are to be secured by 12, 13 to the pickets which they drive.

10, 11 pass the falls under the limbers to the front; 2, 3, if the gun is to be embarked, or if to be disembarked two of the men in the raft, pass them through the blocks attached to the carriage; 4, 5 then pass them through the leading blocks and hand them to 10, 11, who stretch them out to the rear; 12, 13 attend to the running ends.

In embarking the gun, as soon as the tackles are hooked and the falls hauled taught, the word *back the gun over* is given, which is done by 2, 3, 4, 5, 6, 7.

When the wheels are on the brink or edge of the bank, *halt, run the crane up*, to be performed by the same numbers; when far enough forward, *halt, lock the wheels*, to be done by 6, 7, who then stand by the falls—*lower away*—they act accordingly.

The waggon body is then lowered in a similar way, perch foremost, the blocks being secured to the axletree on the outside of the body; after which, 2, 3, 4, 5 embark the limber boxes of the gun, and 8, 9, 10, 11 those of the waggon.

In disembarking the gun, when the crane has been run to the bank, wheels locked, and tackles hooked, *hoist away* when arrived at the crane, *halt, unlock the wheels; run the crane in*—to be done by the same numbers as before; the men at the falls hauling in on them.

If the gun is to be embarked dismounted, 2, 3 sling it, and hook the fixed blocks to the slings.

If to be disembarked, this is to be done by two of the men on the raft.

Should the gun be a 9 pdr. fourteen men will be required for the operation, and if of greater weight, sixteen or eighteen men; the duty of the additional men will be merely that of pulling and hauling.

Note.—Although the directions for performing this manœuvre, are given for limbers having shafts, it may be done with limbers having poles, by lashing one or two spare poles to the limber pole, as directed for shafts.

SECTION 11.

TO FORM A TEMPORARY CRANE WITH A HEAVY GUN ON A SIEGE CARRIAGE.

The cheeks of the carriage are to be placed on as many blocks of wood, laid on the bolster of the limber axletree, as will raise the trail sufficiently high to admit of the weight when hoisted being clear of the ground, and so the carriage being moved backwards and forwards, with the weight suspended to the tackles. These pieces of wood may be in a rough state, all that is required, being that their upper and under surface be perfectly smooth, so that they may rest firmly on each other.

The carriage and limber are to be perpendicular to the bank or wharf.

The limber is to be backed so close to the gun carriage, that the wheels of the carriages may not be more than 6 inches distant from each other; the cheeks resting on the upper block of wood. In this situation the trail will project so far beyond the wheels of the limber, that the tackles will swing clear. The gun and limber are to cover each other exactly ; the draught chain to be hooked as tight as possible.

Attention must be paid that the trail of the carriage does not project too much over the limber ; for, in this case, the lever, that is the trail, may be so much lengthened, that when the body which is to be hoisted is suspended to it, it might overcome the weight of the gun and carriage, and raise them off the ground ; this might be prevented by two or three men bearing down on the gun.

The above inconvenience, however, could only arise, when a gun was made to raise another of equal weight.

Unless the edge of the wharf or bank be very solid, there must be laid some planks, or a platform, or some very firm bearing for the wheels ; for in every case, the limber ones must approach very near the bank, and the ground therefore must be hard and level, so that the crane can be run backward or forward without difficulty.

The gun or weight is to be slung in two places at equal distance from the centre of gravity, the slings about three feet distant from each other ; they must be hauled so tight, that they will not give above two or three inches when the tackles are worked.

As the trail can project but a very little way over the edge of the wharf or bank, it may be necessary to sling the gun or mortar vent outwards, which will bring the trunnions to be vertical. When slung in the proper way, the trunnions from their projection might rub against the wharf, or enter into holes, and thus render the raising of the gun more difficult.

The following implements and stores will be required for the operation.

2 pieces of wood, each about 1½ feet long, 10 inches wide, and 6 inches thick, hollowed out on the under side so as to fit the upper surface of the bolster of the limber axletree, and placed on the bolster on each side of the pintail.

1 piece of wood (or two) about 4½ feet long, 10 or 12 inches broad, 10 inches deep in front, and 8 inches in the rear, with a hole in the middle for the pintail, to be laid in the direction of the bolster over the two pieces above mentioned; if not bevelled at the top, there will be required 2 thin wedges to be placed on the last mentioned piece of wood; on these the under side of the cheeks of the carriage are to rest.

1 piece of skidding, 5 feet long, 6 or 7 inches square, to be lashed across the upper surface of the trail.

2 lashings of 2 inch rope each 3 fathoms, for securing the above to the trail.

2 lashings of 2 inch rope, each 3 fathoms, for securing the cheeks to the limber.

2 lashings of 2 inch rope, each 3 fathoms for securing the pole to the cheeks.

4 double 12 inch blocks.

2 falls for ditto, of 3½ inch rope, the length must depend on circumstances.

2 lashings of 4 inch rope, for the leading blocks, each 3½ fathoms.

2 gaskets of 3½ inch rope, each 2 fathoms, for stoppering the fall.

2 pieces of 4 inch rope for slinging the gun} breech part 3 fathoms, muzzle part 2 fathoms.

2 guys of 1½ inch rope, for breech and muzzle rope; the length depends on circumstances.

6 or 8 common handspikes.

8 wedges for scotching the wheels, and perhaps some pieces of skidding.

Should there not be men enough to raise the gun with the above purchase, there will be required in addition 2 luff tackles complete, the falls of 2½ inch rope, and each about 20 fathoms long.

2 lashings 2½ inch rope, each 1 fathom, to secure the fixed blocks.

2 selvagees.

One non commissioned officer and ten men will be sufficient to make all the arrangements, and manage the tackles, but men will be required for hoisting.

Prepare to unlimber—unlimber—2, 3, 4, 5 lift the trail so high that the muzzle of the gun bears and rests on the ground 10, 11 bear down the muzzle.

Back the limber and place the blocks 6, 7, 8, 9 back the limber, until the wheels are within six inches of the gun carriage wheels, they then place the blocks on the limber bolster, after which the trail is hauled down, 10, 11 bearing up the muzzle.

Lash the cheeks and prepare the tackles 6, 7, 8, 9 lash the cheeks, observing to arrange and tighten their lashings, so as that the under part of the cheeks may bear equally on the upper surface of the block of wood or of the wedges; after which, 8, 9 will fasten the gaskets or stoppers to each cheek, close to and between the centre transom and the axletree. 2, 3 take out the pole if moveable, if fixed, it passes under the axletree and is secured by a lashing, and then with 4, 5 place the trail piece of skidding across the trail, where they will lash it; 4, 5 then lash the fixed blocks of the tackles to the cheeks of the carriage, and hang them over the piece of skidding, and outside of the cheeks; 2, 3 sling the gun or mortar, and have charge of the moveable blocks, and hook them to the slings; they stopper the fall; 10, 11 will lay the two falls properly coiled in front of and on each side of the gun.

Reeve the tackles—10, 11 pass one end of each fall between the wheels and the gun carriage to 4, 5, who reeve them through the outside sheaves of the fixed blocks, giving them to 2, 3, who reeve them through the outside sheaves of the moveable blocks; they are then passed through the inside sheaves by the same numbers: after which, 2, 3, 4, 5 fasten them to the piece of skidding which is lashed to the trail;

or they are to be laid over the trail transom, and passed by 6, 7 between the cheeks and under the centre transom and axletree of the gun carriage, where they are to be received by 10, 11, who take a turn with them round the chase of the gun, and secure each to its own standing part by two half hitches. 2, 3 fix the breech and muzzle ropes; every thing is now ready for proceeding with the operation.

Run the carriage forward—To be done by the whole of the men; 8, 9, 10, 11, with handspikes if necessary—if not, 10, 11 man the gun wheels inside, and 6, 7, 8, 9 outside; 2, 3, 4, 5 the limber wheels outside; when the tackles are over the gun, *halt.*

Scotch the wheels—this is done by 6, 7.

If the gun is on shore and to be embarked, *hook the tackles*—to be done by 2, 3; but if the gun is to be disembarked, *ease off* or *over haul the tackles*—to be done by 2, 3, 4, 5; when the blocks are taken hold of by the men in the boat, *halt—hook the tackles*—to be done by two men in the boat who will have previously put the slings on the gun, and fixed the breech and muzzle ropes.

Heave in the slack—the slack of the falls is hauled in by 4, 5, 6, 7, 8, 9, 10, 11, and the working party.

When the falls are well taught, *hoist away*—when high enough, *stopper the fall,* by 2, 3. *Ease off the fall—unscotch the wheels*—by 6, 7.

If the gun is to be embarked, *run the carriage forward*—the carriage is run forward until the trail of it projects sufficiently for ever the edge of the wharf; *halt—scotch the wheels—take a turn with the fall round the nave*—this is done by 10, 11, assisted by 8, 9; the slack to be then hauled well taught, and 8, 9, 10, 11 hang on the fall ready to lower away; *unstopper the fall—lower away*—which they do gently.

When luff tackles are employed, 10 places a handspike in the bore, to which 12, 13 lash the single or fixed blocks; 6, 7 fleet the tackles, hook the double blocks to the selvagees, which are to be applied and shifted by 4, 5.

When in hoisting a gun it has been raised so high, as to allow of the carriage being run in from the edge of the wharf, the fall is stoppered; the bowsing tackles eased off; the crane run in and the gun lowered.

SECTION 12.

TO RAISE A GUN WHICH IS AT THE BOTTOM OF A RIVER OR DITCH OF A FORTIFICATION.

A raft is required for this purpose, composed either of two or four pontoons or boats, according to the weight of the gun; the superstructure or platform of which is to be so arranged, that it can be opened or uncovered in the middle, and thus allow of a passage for the gun when it is being raised.

The depth of water is supposed not to exceed 7 or 8 feet, for in ordinary circumstances without special means for the purpose, the difficulty of getting hold of and slinging a gun at a greater depth is very considerable.

The triangle gyn is raised directly over the opening in the middle of the raft; its legs must be lashed and secured so as to remain immoveable: the feet ought to rest on thick pieces of plank to prevent them from forcing their way through the platform.

The raft will require three anchors or grapnels, but four are better, one at each angle, for the purpose mooring it immediately over the spot where the gun is.

The most difficult part of the operation is slinging the gun; if the water be muddy, a man or two who can dive ought to ascertain its situation. Should it have dolphins, and they be uppermost, the operation will be easy. If the gun be lying vent downwards, the trunnions might be so far from the bottom, as to allow of a strong rope being passed under each trunnion, and across the upper surface of the piece as it then lies; if the bottom be soft, a man or two may be able to clear away so much of the mud from under the trunnions, as to allow of the gun being slung in the above mode; or it may happen from the hardness of the bottom, that the usual gun slings may be applied to the neck of the cascable, making use of a small fid or handspike, which could easily be put in the bore. A pair of very large pincers of a particular construction, have sometimes been successfully employed for the purpose, even when the gun was in deeper water than 8 feet.

When the gun has been slung, and raised sufficiently high, the platform of the raft is to be relaid, and the gun lowered on two pieces of skidding placed to receive it; the anchors are then got up, the raft rowed or poled to the shore or bank and the gun disembarked. Great attention is to be paid, always to keep the raft on an even keel.

The following implements and stores will be required for the operation.

1 *raft completely equipped, of* 2 *pontoons for an* 18 *pdr. and* 4 *pontoons for a* 24 *pdr.*

1 *triangle gyn complete with tackles, slings, &c.*

Skids each, 6 *inches square.*	2, *each* 9 *feet long, for the gun to rest on.*
	2, *do.* 3 *ditto.*
	2, *do.* 2 *ditto.*

3 *pieces of* 3 *inch plank, each* 3 *feet long, and* 1 *foot broad, for the feet of the gyn to rest on.*

4, 24 *pdr. or* 18 *pdr. quoins or wedges.*

4 *scotches or small wedges.*

Pieces of tarred rope, . .	3½ *inch*	1 *for slinging the gun* 3 *fathoms*
		1 *spare ditto ditto.*
	1½ *inch*	2 *for securing the feet of the cheeks, each* 3 *fathoms.*
		1 *for securing the foot of the prypole,* 6 *fathoms long.*
		2 *for breech and muzzle ropes, each* 3 *fathoms.*

6 *common handspikes*

One non-commissioned officer and fifteen men will be sufficient for the operation, they erect the gyn, arrange the skidding, manage the raft, cast and weigh anchor, &c.

The gyn having been laid, and put together on the raft, the prypole will project over the gunwale; the feet of the cheeks are to be lashed to the raft by 2, 3, 4, 5.

The prypole rope is fastened to the prypole by 10, 11. who will man it, assisted by 8, 9; all the other numbers lift at the cheeks of the gyn.

Raise the gyn—the head of the gyn is lifted, the prypole is hauled in by means of the prypole rope, and the gyn is erected without difficulty; it is then to be properly placed, and the feet finally secured by 2, 3, 4, 5, 8, 9.

2, 3, 4, 5 put on board the long pieces of skidding, and 6, 7, 8, 9 the small pieces.

2, 3, 4, 5 have charge of the setters, or of the oars, and pole or row the raft to its place.

6, 7, 8, 9 have charge of the anchors and cast and weigh them ; 10, 11 steer and have charge of the steering oars.

The gyn is worked by the usual numbers.

In proportion as the gun is raised, 10, 11 will, each with a boat hook guide it in such a manner, as to make it freely enter through the opening in the platform ; if required, they fix the breech and muzzle ropes.

SECTION 13.—DERRICKS.

A derrick is a sort of crane, principally used on board of ship for hoisting heavy weights. It consists of a beam of wood which is always kept in an oblique position like a crane ; one end of it rests on the deck, the other is supported at any angle, by guys. On shore it also requires fore guys, which are slacked off to allow of the head being drawn in, and the weight deposited at the foot of the derrick. The ends of all the guys must be securely fixed.

Should there be only 3 back guys, one of them is to be in prolongation of the derrick itself, when its direction is perpendicular to that of the edge of the bank or wharf, and the other two at equal distances on each side of it ; the fore guys to be at corresponding distances in front.

This arrangement however only provides for the derrick being hauled in or hauled out in one direction. When the head is to be traversed round like a crane, there must be a series of guys attached to posts, on the side opposite to that to which the head of the derrick is to be traversed, and driven on the curve of an arc,of which the foot of the derrick is the centre.

The tackle is secured to the derrick at a proper distance from it s head, and the running end of the fall passed through a leading block secured to the foot, and led from thence to a crab capstan, or manned by a party sufficient to raise the weight by hand.

The foot of the derrick must be sunk into a hole, so that it can resist the action of the fall on the leading block, or it may be placed in an excavation made for it in a solid block, of wood sunk in the ground.

The foregoing is but a temporary resource, and can only be employed to raise light weights, and when pressed for time.

Whenever there is time and materials, a large spar or square beam of timber, 25 or 30 feet long, should (like the main post or beam of a crane,) be sunk 6 or 8, or more feet in the ground, and solidly fixed, passing through a slab of wood, about 7 or 8 inches thick, 6 feet long, and 3 feet wide, and kept in its place by 4 cleats bolted to the large beam ; in this slab an excavation is made for the foot of the derrick. One tackle, and sometimes two are fixed at a proper distance from the top of the derrick, and top of the beam, by which means the derrick can be kept at any angle it may be thought necessary.

The main beam has also, four, five, or more guys attached to it, secured to posts driven in a proper direction. One or two guys will be required for the head of the derrick, that it may be completely under command.

The following implements are required.

1 *main beam, about* 12 *inches square, or* 12 *inches in diameter for half its length, and diminishing to about* 10 *inches at top ; and about* 25 *or* 30 *feet long.*

1 *slab or frame of wood as described.*

4 *strong cleats.*

1 *derrick about* 30 *feet long and* 9 *or* 10 *inches in diameter.*

5 *guys at least for the main beam of* 3 *inch rope, each about* 10 *fathoms.*

5 *large posts for these guys.*

2 *or* 4 *(as may be thought necessary,)* 12 *inch blocks for the tackles, to haul in or ease off the derrick, and give it the proper inclination.*

2 *falls for ditto,* 3 *inch rope, each* 6 *fathoms.*

4 *lashings for these blocks,* 2 *inch rope, each* 3 *fathoms.*

2 *guys, 2 inch rope, each 10 fathoms, for the head of the derrick, to make it traverse.*

2 *posts for these guys.*

1 *main tackle complete, similar to the tackle for the gyn or for sheers, with slings, &c.*

1 *lashing, 3 inch, for upper block, 3 fathoms.*

1 12 *inch leading block.*

1 *lashing, 2 inch, for ditto, 3 fathoms.*

2 *muzzle and breech ropes, or guys for the gun, 1½ inch rope each 6 fathoms.*

1 *stopper for fall, 3½ inch rope, 2 fathoms.*

2 *wood mallets.*

1 *crab-capstan.*

1 *post for ditto.*

1 *lashing for ditto, 4 inch rope, 7 fathoms.*

8 *handspikes.*

Skids if required.

One Non-Commissioned officer and twelve men will be required for the derrick, independently of a party in the boat.

2, 3, 4, 5, have charge of the handspikes, skids, &c.

2, 3, fix the leading block and gasket to the foot of the derrick; stopper and unstopper the fall; sling the gun if it is to be embarked, and hook the lower block of the main tackle to the sling; if to be disembarked two men in the boat do this; 1 assists in hauling in, or easing off the head of the derrick.

4, 5, if luff tackles be used, fix selvagees, &c.

6, 7, hook the main tackle to the head; 6 mounting to the top; the upper block may be hoisted to the top by means of a small tackle; they have charge of the derrick guys. When the head of the derrick has been placed over the weight, it may be maintained in that position by tightening these guys. When the weight has been raised sufficiently high, and is to be shoved out, or hauled in, they will ease off or haul upon the guys, recollecting they are not to be entirely cast off the posts, in order that they themselves may never be overpowered, and that the movement of the derrick may be uniform, and without jerks.

8, 9, 10, 11, 12, 13, place and work the capstan, and assist the other men, if necessary.

If the fall is to be worked with luff tackles the arrangements will be exactly as has been detailed in preceding sections.

SECTION 14.—ANOTHER CRANE.

In the event of want of materials, either in size or quantity, or when the space for working in is confined, as on the tops of towers, the following mode has been practised to get guns up the scarps of works.

Two pieces of skidding about twelve feet long and of a proper scantling, are fastened to each other, and set up as sheers, the legs at the bottom being about ten feet from each other. On the crutch or part where the sheers cross, a beam of twenty-five or thirty feet long is laid and lashed, projecting so far over the sheers, as that, when the tackle is secured to its end, it may as much as possible be clear of the scarp; it is however always to be recollected that the less it projects the better.

The other end of the beam is sunk two or three feet in the earth, butting against a post or two, or a board, to prevent it from coming inwards when the tackle is worked, this end must be loaded with stones, or shot, or sand bags, and so prevented from flying up; this may also be done by driving posts over it, and on each side of it close to the end; they must be driven in an oblique direction crossing the beam; the under side of each post bearing on the upper surface of the beam.

The reason for doing this will be evident when it is recollected, that the beam is in fact a lever, the counterlever of which is that part of it which projects from the sheers over the escarp; all then which is required, is to confine or load the other end of the lever with such a weight as to counterbalance the gun or weight which is to be raised by the tackle attached to the counterlever.

A back guy is required to prevent the sheers from falling forward, but there is not any occasion for a fore guy, as the end of the beam is let into the ground or butts against it.

When the gun has been raised sufficiently high, it is to be brought into the work breech foremost, as is practised in getting a gun through a casemated embrasure— Section 5, page 84.

Should the lever or beam not be strong enough, it may be strengthened by fishing or lashing pieces of wood to it; it may also be lengthened by a similar process; each leg of the sheers may be made up in the same way; two half balks or three twelve feet levers will do for this purpose.

The arrangement for a leading block, stopper, &c. is the same as for sheers.

The best and most convenient way of working the fall will be by a luff tackle; by this mode fourteen or sixteen men can raise a 24 pounder.

The following implements will be required.

2 *pieces of skidding or short balks about* 12 *feet long each, and* 6 *or* 7 *inches square.*

1 *spar from* 25 *to* 30 *feet, or* 35 *feet long.*

1 *lashing for top of sheers,* 2½ *inch rope,* 5 *fathoms.*

1 *lashing for securing the spar to the sheers,* 2½ *inch rope,* 5 *fathoms.*

1 *lashing,* 3 *inch rope,* 4 *fathoms long, for securing the upper block of the main tackle to the spar.*

2 *lashings,* 2½ *inch rope, each* 2 *fathoms, for securing the feet of sheers.*

2 *posts for these lashings.*

1 *back guy,* 4 *inch rope, the length depends on circumstances.*

1 *post for ditto.*

4 *or* 6 *posts for the inner end of the spar.*

2 *spades or mamoties.*

2 *pickaxes.*

2 mallets.

6 handspikes.

1 or 2 planks for rollers to move on, with pieces of skidding to make them horizontal, if necessary.

2 20 inch rollers.

2 wedges for chocking rollers.

1 gyn tackle with fall complete.

2 muzzle } *ropes, 2 inch rope, the length must depend*
2 breech } *on circumstances.*

1-12 inch leading block.

1 lashing for ditto, 2½ inch rope, 3 fathoms.

1 gasket for stoppering the fall, 3½ inch rope, 2 fathoms long.

1 piece 3½ inch rope, 2½ fathoms, for slinging the gun.

1 luff tackle complete, fall 2½ inch rope, 45 fathoms.

1 selvagee.

1 post.

1 lashing 2½ inch rope, 2 fathoms.

By using two luff tackles, the work can go on without interruption, but then more men would be required.

2, 3 drive the posts for the foot ropes, and secure the feet of the sheers to them; they sling the gun if it is to be lowered from the rampart, but, if it is to be raised, this is done by two men at the foot of the scarp; fix muzzle and breech ropes; lash the leading block to the foot of the sheers; fix the gasket; stopper the fall; but if wanted to man the tackle, 1 stoppers the fall.

4, 5 lash the balks or top of the sheers together, and, assisted by 6, 7, lash the spar to the crutch; they fix the back guy to the top of the sheers; fix selvagees.

6, 7 lash the top of the sheers together; and, assisted by 4, 5, lash the spar to the crutch; they hook and lash the upper block of the main tackle to the end of the spar; place and shift the rollers for the gun to move on, either when brought into the work or lowered from it; if the ground be irregular, they lay a plank or two for the rollers; reeve luff tackles with 12, 13, and fleet the blocks.

8, 9, 10, 11 dig the hole for the inner end of the spar, and place the plank against which it is to abut; drive the posts over this end, and load it with sand bags, or other weights, according to circumstances.

12, 13 drive post for back guy; secure its end and attend to it; reeve luff tackles, secure the fixed blocks to the post, and attend to the running ends of falls.

The sheers with the spar attached to them are raised by hand; all the men are employed for this purpose except 12, 13, who attend to the back guy, and ease it off, and haul it in, as may be required when the inner end of the spar is lodged in the hole dug for it, the pickets for keeping it down are driven.

FINIS.

MACHINES, &c.

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MILITARY PYROTECHNY.

MILITARY PYROTECHNY.

This art is properly divisible into two branches, namely, that for military purposes, and that intended solely for shew or amusement. The military branch is very limited, but it is proposed here, to give some practical memoranda in what is usually termed "Laboratory Work" and such parts of it, as are now in use in the Madras Artillery.

LABORATORY COMPOSITIONS AND STORES.

All Laboratory Compositions may be included under three denominations.

1st.—Dry or those which only require the simple mixture of ingredients.

2d.—Those, in preparing which a liquid is used in mixing, whether as a necessary ingredient, or to give consistency to the dry portions.

3d.—Those which require the application of heat to reduce some of the ingredients to a fluid, or other proper state, to admit of their mixing with the rest.

DRY COMPOSITIONS.

1. The ingredients of all compositions that are to be mixed dry, should be separately reduced to the mealed or pulverized state, and after being correctly weighed out, are to be well ground with rollers, then mixed with the hands and passed through hair or lawn sieves, (hair are the best) that the ingredients may be properly incorporated.

WET COMPOSITIONS.

2. The several ingredients must be separately weighed in their dry state, or measured in their liquid state, pour the liquids into a proper vessel, to which add the dry ingredients by small quantities at a time, stirring the composition well, that lumps may not be formed.

COMPOSITIONS THAT REQUIRE FIRE

3. If grease enters into the composition, it is first put into the pot to prevent the other ingredients sticking to the sides and bottom, if none is included, still the bottom and sides of the pot should be greased over, the other ingredients

may be added by handfulls through a cylindrical funnel, taking care to have the unmixed masses at such a distance, that, should that in the cauldron take fire, the dry unmixed ingredients would be secure, with these precautions little danger is to be apprehended.

4. If gunpowder enters the composition, a second cauldron should be at hand filled with hot water, in which (having previously taken it off the fire) the mixing cauldron should be dipped or placed whilst adding the gunpowder.

5. With every precaution, inflammation will sometimes occur, but if the mixing cauldron has a lid, exactly fitted to it, and that lid is always kept ready to put on, the fire may be easily smothered. The lid should have a ring in the centre, through which to put a bamboo or handles, the cauldron should have also on each side, receptacles for bamboos, or be provided with iron handles, by these means the lid may be put on, and the whole removed from the fire, and covered with damp powder cloths or gunnies if necessary, but if the lid fits well, the act of putting it on will generally suffice to extinguish the fire.

GENERAL PRECAUTIONS.

1. Before entering the composition or mealing and mixing room, the men employed on Laboratory work, are to be warned, that very great caution and care is indispensably necessary, to guard against ignition in a room, the whole extent of which must be more or less filled with floating particles of the most inflammable matter.

2. All articles of iron, or having any part of iron, whether of dress or implements, should be prohibited in the composition room, and all hammering, wrenching or forcing, strictly guarded against, such operations when required, are to be executed in the working room, or other appropriate place.

3. Particular care must be taken that no particles of iron, sand, stone or other extraneous matter, be mixed with the powder or compositions, otherwise the powder might ignite in the mealing, or the composition when driving, a very small particle of flint, might blow up a whole table.

4. All mealed ingredients are to be sifted through sieves having leather tops and receivers, which will prevent the finer particles escaping to the injury of the composition.

5. The men employed driving composition of whatever kind, should keep their bodies in an erect position, so that

if the composition should by accident ignite, their heads and bodies would be quite clear. A small quantity of composition only should be in each box, not exceeding 2lbs. for portfires and 1lb. for fuzes, during the hot winds the above precaution is particularly necessary, as minute fragments of sand and stone frequently blow about.

6. The box containing the composition should not be placed on the fuze or portfire block, but on separate benches. If the box is placed on the block, the saltpetre would at each blow be shaken to the bottom, and the charcoal to the top, and thus destroy the nice admixture so necessary to be obtained.

7. In all cases it is to be observed that the strength of composition does not more depend on the ingredients, than on the effectual manner in which they are blended, and the mode in which they are made up for service.

BAGS STARTING.

Are made of coarse cloth, and hold a small charge of powder, for starting the fuze of a shell, they are only used at mortar and howitzer practice. This bag with its charge is put into the fuze hole of the shell and the fuze set tight within it, the powder igniting when the composition has burned through; it shows where the shell would have burst, had the proper charge of powder been inserted, also whether the fuze was long or short.

Powder for starting Fuzes.

13	Inch	4 oz.	0 drs.
10	do.	3 „	0 „
8	do.	2 „	8 „
5½	do.	1 „	4 „
4⅖	do.	1 „	0 „

Articles required.

Scissors..........Former.
Needle...........Thimble.
Cup for containing marking ink.

BAGS BURSTING.

Are small bags or cartridges, made of cloth, in which are put the charges of powder, for bursting common shells or spherical case shot. They are carried in the copper boxes of light field carriages, and when required to load the shells, the powder is poured from them by a funnel, the empty cartridge being returned to the limber.

Powder for Bursting.

Spherical Case shot.	24	Pdr. or 5½ inch	6 oz.	0 drs.
	18	do.	5 „	0 „
	12	do. or 4⅖ inch	4 „	8 „
	9	do.	3 „	8 „
	6	do.	2 „	8 „
	3	do.	1 „	8 „
Common Shells.	24	Pdr. or 5½ inch	12 „	0 „
	12	do. „ 4⅖ „	8 „	0 „

Articles required.

Scissors..........Former.
Needle..........Thimble.
Cup for containing marking ink.

BALLS FIRE OR LIGHT.

Are similar to carcasses having the same number of holes, but the case is made of paper. They are used in sieges in dark nights, for the purpose of discovering Working parties, &c., they answer on some occasions to set fire to Buildings, but the cases being made of paper, they are not heavy enough to break through roofs.

Table of Fire or Light Ball Cases.

Nature of Ball.	Weight.				Diameter.		Thickness of Case.	Diameter of Fuze hole.	
	Empty		Filled		Interior	Exterior		Exterior	Interior
	lb	oz.	lb	oz.	ins.	ins.	ins.	ins.	ins.
13 Inch......	14	8	28	,,	9.60	12.80	1.60	1.84	1.70
10 do.	7	6	16	,,	7.00	9.80	1.40	1.57	1.45
8 do.	3	12	6	12	5.60	7.80	1.10	1.325	1.227
5½ do.	1	2	3	8	4.04	5.54	.75	.894	.826
4⅖ do.	,,	,,	,,	,,	3.20	4.40	.60	.832	.769

Method of Forming the Cases.

The former or block on which the case is formed, must be equal to the interior diameter of the case, it is first greased all over with tallow to prevent the paper sticking to the block, and a slip of paper from 2 to 3½ inches wide, (according to the size of the case) well pasted is put upon it, beginning at the nail, which is continued all round, another slip is put on it in a contrary direction to the other, which will form the quarters, pieces of paper are cut to fit them so that they may just come upon the edges of the other pieces, another coat is put on in the same manner, but the slips of paper are made to cover the quarters, after this any shaped pieces of paper will answer, taking care they are not too large, when the case is about ½ tenth of an inch thick, it is put out to dry, and when near dry, the coating of paper is continued, until it is one-tenth of an inch thick, it is then perfectly dried, and the block taken out, by cutting the case into equal parts, leaving about an inch uncut to form an hinge, the block being taken out, the case is again closed, and a slip of paper well pasted, put all round the case, when this is dry, four or five coats are put on, and occasionally beat with a small mallet to make it firm, when nearly dry more coats are put on, and as many more as may be requisite to bring it up to the gauge, the case to be put out to dry partially after every five coats. When brought up to the proper size and perfectly dry, they receive two coats of red paint, the holes are then cut with a brace bitt, and the sides of them seared with a red hot iron to harden them.

For filling fire of Light Balls—Composition No. 1.

Saltpetre..........	6 lbs.	5 oz.
Sulphur...........	2 „	8 „
Resin.............	1 „	14 „
Linseed Oil........	0 „	8 „

The process of mixing and driving the composition is similar to that with carcasses, the dry part of the composition being well mixed and pulverised, is added in small quantities to the oil while boiling. The same precautions are equally necessary in preparing fire balls as in carcasses.

Composition No. 2.

Saltpetre refined......	21 lbs.
Sulphur do.	7 „
Chunam sifted	$1\frac{3}{4}$ „
Indigo do.	7 oz.
Camphor	14 „
Ghee................	7 „

The dry ingredients are well mealed, the ghee and camphor are then added, and the whole well mixed with the hands until the mixture appears of one uniform color.

Priming fire or light balls is the same as with carcasses.

Articles Required.

Block or Former.
Mixing Boxes.
Rollers.
Scrapers.
Mortar and Pestle.
Sieves.
Pans, Copper.
Boiler.
Spatula.
Drifts, Wooden.
Mallets.
Knives.
Scissors.
Brushes.
Kettle Dammer.
Plugs.
Funnel.
Gunnies.

Colonel Jones says, Light Balls are of such excellent use in discovering working parties, that some means ought to be taken, to render them of dangerous approach, by attaching a grenade or other missile so prepared as to explode at certain periods of their burning.

At the late sieges in Europe, two or three bold men of the Engineer Brigade, were always in readiness to run up and extinguish the Fire Balls as they fell, and generally succeeded in a few seconds in smothering them, with filled sandbags or by shovelling earth over them.

The Garrison always directed their fire on the men so occupied, which diverted it altogether from the Working party employed perhaps at a few yards distance from the ball to its right or left. Some casualties occurred to the men so employed, but generally they had extinguished the Light Ball, before a second discharge of Artillery could be brought upon them.

BALLS SMOKE.

Smoke balls are sometimes used on service, the cases of which are formed in the same manner as those for fire balls, but with only one fuze hole and are painted black. The composition is

Saltpetre....................	1	lb.
Mealed powder..............	5	,,
Sea Coal......................	1⅓	,,
Swedish pitch...............	2	,,
Tallow........................	½	,,

These are mixed in the same manner as composition for carcasses. In filling the cases the following dry composition is introduced in three portions as follows ; one portion when the case is one quarter filled, a second portion when it is half filled, and the remaining portion when it is three-quarters filled. They are primed in the same manner as fire balls.

Sulphur	1	oz.	for 10 and 8 inch.
Sea Coal	1	,,	
Sulphur	½	,,	for 5½ and 4⅖ inch.
Sea Coal	½	,,	

The same articles are required as with Fire Balls.

BOTTOMS FOR SHOT AND SHELLS.

Bottoms are made of any good, seasoned tough wood, hollowed out, so as to admit of one-third of the shot. The diameter of the bottom, should be of the standard shot or shells diameter, their height equal to half the diameter.

There are several methods of fixing bottoms to shot.

1st. With solder, as done in the Royal Arsenal at Woolwich.

Grind a circle of an inch diameter on the shot till perfectly clean, then take a lump of sal-almoniac, and after dipping it in cold water, rub the clean surface until it assume a white appearence, when it must be placed on a stove to dry—as soon as the part rubbed becomes brown, which on a hot stove will be in 5 or 6 minutes, the shot are ready for tinning, which must be done as follows :—Melt block tin in an iron pot, till it assumes a yellow hue (if it becomes blue or brown it is over-heated) and put in the shot, which must be taken out, and rubbed with dry sal-almoniac on the prepared part, and again dipped in the metal, when they will be found perfectly tinned. They are then to cool till they can just be handled, when the wooden bottom, accurately fitted to the tinned part, must be fixed by the application of a tin stud, and as much solder as will make an even surface, by a proper iron.

In fixing shells, a stick about a yard long, one end fitted to the fuze hole, with a groove to admit of the air escaping, will be found useful. Care should also be taken to prevent the tin from entering the shell.

2d. With solder as done at the Arsenal of Fort St. George.

Grind a circle of an inch diameter on the shot till perfectly clean, then take a lump of sal-almoniac, and after dipping it in cold water, rub the clean surface till it assumes a white appearance, place it on a charcoal fire, and when sufficiently hot, apply a little powdered sal-almoniac to the spot, which will smoke if sufficiently hot, then apply a red hot soldering iron and a piece of pewter solder, rub it on until perfectly tinned, when cooled a little, the wooden bottom is accurately fitted to the tinned part, and fixed by the application of a concave tin stud, 2 inches diameter, with a hole half an inch diameter, and as much solder with resin or sal-almoniac, as will make an even surface of the concavity in the stud, by a soldering iron bent at right angles.

The shot or shells are placed in a shallow box of wet sand to cool.

3d. With glue.

Bottoms are fixed to the shot with a composition of equal parts of resin and glue, which after being well pounded in a mortar, are put into a convenient vessel, with sufficient water to prevent the composition being burnt.

When the composition is well melted, it is applied to the inside of the bottom with a brush, a little well picked oakum from Europe junk, is laid evenly in the bottom, and the shot having some composition applied, to a part of its surface, is put in it, and firmly pressed down and laid to cool.

Another method of fixing bottoms to shot with glue, but more expensive than the former, is, when the composition is well melted, a quantity is poured with a ladle, into the hollow of the bottom, and rolled about until it adheres all round, the shot is then put in, and pressed down, forcing out the surplus composition, which is taken off the side of the bottom with a knife.

4th. With Dammer.

Dammer............	1 part.
Oil.................	1¼ do.
Brick dust..........	2 do.

The dammer is first melted over a fire and quite dissolved, the brick-dust finely powdered and sprinkled upon it, and the whole moved about by a spatula, the oil is then added, and when the composition is well mixed, it is made into sticks or balls for use, the composition is to be pounded when used, and the shot applied when perfectly hot.

None but smooth and even shot are fixed to bottoms for Field guns, and care must be taken, that each shot is passed through the gauge, both before and after fixing the bottoms. If any part of the shot is more uneven than another, though not sufficient to condemn it, that part must be inserted in the bottom.

Use of Bottoms.

The wooden bottom keeps the projectile in its proper place, whilst it is being sent home. It prevents the shot knocking about, which so soon destroys guns. In preventing this the wooden bottom lessens the rotary motion, which is a great cause of the deflection of shot; finally it increases the range. The conical bottoms used with the new howitzers, increases the range more than the common one, but great care is required in using it, for if not sent home carefully, the shot or shell will stick half way.

Articles Required.

1*st Method.*
Stove.
Stone grinding.
Soldering iron.
Melting pot.
Gauges.

2*d Method*—Stone grinding.
Soldering iron.
Box for sand.
Gauges.

3*d & 4th Method*—Chattie.
Brush.
Gauges.

CARCASSES.

Carcasses differ from common shells, in having 3 fuze holes, and a greater thickness of metal.

Table shewing the Weight and Diameter of Carcasses.

Nature.	Diameter	Weight			
		Empty.		Filled.	
	inches.	lbs.	oz.	lbs.	oz.
13 Inch....................	12.84	195	,,	212	14
10 ,, ...	9.85	90	4	97	8
8 ,, ...	7.85	48	,,	50	14
5½ ,,—or 24 Pdrs.........	5.54	15	6	16	9½
4⅖ ,,—or 12 ,, ...	4.44	8	6	8	13

To Fill Carcasses.

The following is the proportion of ingredients for Carcasses.

	lbs.	oz.
Saltpetre refined..............	6	4
Sulphur.....................	2	8
Antimony....................	,,	10
Venice turpentine.............	,,	10
Resin........................	1	14
Tallow.......................	,,	10
Gunpowder mealed............	,,	11

The necessary precautions to be taken.

Make the fire place in a convenient place, and fit the boiler or pot to the top quite close, leave an opening on one side to feed the fire, the dry composition being at some distance, the man that holds the spatula to stand clear of the pot. A wooden cover, to fit close round the top of the pot, with two long handles passing through rings at the top, and wet gunny bags or powder cloths, should be kept at hand. If the composition takes fire, put on the cover and take away the handles, this will keep down the flame, until the wet gunny bags, &c. can be laid on, which will put out the fire. A copper funnel about 4 feet long will be found very useful in putting the dry composition in the pot, and save the trouble of taking the pot off the fire.

The antimony and resin are first well pounded in a mortar and then passed through a brass wire or hair sieve. The saltpetre and sulphur are also to be well mixed in a mixing box, and afterwards passed through a hair sieve. The tallow is melted in a 5 gallon boiler, the pitch and resin being added ; when in a boiling and liquid state, the saltpetre and sulphur are carefully put in by handfuls, at a time, into the centre of the pot, the whole mass being kept well stirred round with a wooden spatula tipped with copper, the antimony and gunpowder are put in the last, this requires great care, the safest way is to take the pot off the fire, then put in the two latter ingredients and after they are well mixed, place the pot over the fire again. When the whole mass is sufficiently mixed, the pot is taken off the fire to the carcasses, which are to be filled, either by pouring the composition in, or with pieces put in by the hand, the composition is to be well driven with a two pound mallet and wooden drift. Previously to filling carcasses, all the holes except one are stopped up, by driving in wooden plugs, and when filled, a plug is drove in, on which the carcass should be placed to prevent its being forced out by the composition ; the plugs should be greased with tallow, to prevent the composition sticking to them.

To Prime Carcasses.

When the composition is nearly cold, the plugs are taken out, one at a time, and portfire composition driven in hard, to fill any cavities, the holes are than primed by laying two strands of quick match, and driving fuze composition over them hard, to within a quarter of an inch of the top, the ends of the match are then folded in and covered with mealed powder, moistened with spirits of wine, a circular piece of paper is placed over the priming, secured at the edges with dammer, over this a piece of cloth covered with dammer, the carcass is than ready for service. When used the covering is removed and the ends of the match laid open and dredged as with common shells—carcasses will burn from 8 to 12 minutes.

Articles Required.

- Mixing Boxes.
- Rollers.
- Scrapers.
- Mortar and Pestle.
- Sieves.
- Pans Copper.
- Boiler.
- Spatula.
- Drifts, wooden.
- Gunnies.
- Mallets.
- Knives.
- Scissors.
- Brushes.
- Kettle Dammer.
- Plugs.
- Funnell.

The use of carcasses is to fire buildings and they are used in the same manner as common shells.

CARTRIDGES FOR SMALL ARMS.

Are made up of two different sorts of paper, in order to avoid mistakes in serving out ammunition; ball cartriges are made up of Europe whited brown, and blank cartridge of country blue paper.

Each sheet of Europe paper measures 22 inches by 17, and will cut into 12 musket or 16 fuzil papers for ball cartridges. Each sheet of country paper measures 19 inches by 13, and will cut into 12 musket or 18 fuzil papers for blank cartridges.

Casting the Balls.

The moulds are generally made of brass, and cased with iron (with iron handles) in two parts, having a joint at the upper end, each part has generally 6 semi-circles with mouths, and a groove connecting the mouths, when the mould is closed.

The lead is put into an iron pot with half measure of cocoa-nut oil per 100 lbs. and when melted, if any scum should appear, it is taken off with an iron dipping ladle, the lead should not be made too hot, but sufficiently fluid to run freely, otherwise the balls will not be solid.

The metal is taken out with the ladle, and poured into the mould, where it remains about half a minute, then taken out and the gules cut off with the cutting instrument.

To make the balls as round and smooth as possible, they might be rolled between two wooden rollers, worked on a similar principle as the common handmill.

After a dozen casts the mould should be dipped in water to cool, and after every cast cleaned with a rag dipped in cocoanut oil.

The wastage in casting should not exceed 4 per cent. each pound of metal casts musket balls 14½, fuzil or pistol 20.

BLANK CARTRIDGES.

To prepare the case for blank cartridges for muskets, open the sheet of paper, and cut off a slip 13 inches by 2 from the edge of the paper, then fold the 13 inch side into three different parts, which double over, and join their opposite corners, which will give twelve papers.

To prepare the case for blank cartridges for fuzils, from the open sheet cut off a slip 19 inches by two, divide the side reduced to 11 inches into 3, which will form a slip of 19 inches by 3⅔ inches, this is again divided into 3, and the opposite ends brought together will give 18 papers.

To make Blank Cartridges.

The former is made of wood like a ruler about 8 inches in length ·615 of an inch diameter for fuzil, and ·693 of an inch diameter for musket cartridge, the end being hollowed, the former is laid on the paper at the edge between the two right angles, the hollow end next the longest side, but one inch from it for musket, and ¾ inch for fuzil, the cartridge is rolled up, and the projecting paper turned on the former at four different times, the last portion of paper having a twist given to it, this end is placed on the table, and a few taps given to it, the cartridge is then ready for filling.

BALL CARTRIDGES.

To prepare the case for ball cartridges for muskets, open the sheet of paper, and cut off a slip 17 inches by 2¼, then fold the 17 inch side into three equal parts, which double over and joining the opposite corners will give 12 papers.

To prepare the case for ball cartridges for fuzils, open the sheet of paper and cut off a slip 22 by 2 inches, double the sheet into two long folds 22 by 7½ inches, this is then folded into four equal parts 5½ by 7½ inches, and the opposite corners joined which will give 16 papers.

TO MAKE BALL CARTRIDGES.

The former is made of wood, and like a common ruler, being the exact diameter of the ball, or .693 inches for musket, and .615 inches for fuzil, one end is made round, the other hollowed to receive about one-third of the diameter of the ball, the former is laid on the paper at the edge, between the two right angles, the hollow end next the longest side, but 1¼ inch from it for musket, and 1 inch for fuzil, the former is covered with one turn of paper, then the ball placed in the hollow, one thickness of paper being between the ball and powder, to keep it in its place; the paper is then rolled up quick and made firm, by being gently pressed by the palm of the right hand rolling it forward; when rolled, it is taken up with the left hand, and the end next the ball, choked with a clove hitch of Europe twine, the paper outside the hitch is trimmed with a pair of scissors, but not close, a few taps are then given, with a flat mallet to spread the tuft end of the paper; the cartridge is then ready for filling.

Filling Cartridges.

The empty cartridges are placed vertically in a box, and the powder poured into them by a machine for filling cartridges, invented by a person of the name of Coffin. The machine fills cartridges more expeditiously, and with greater correctness as to quantum. It is in shape resembling a common coffee mill, a boy holds it in one hand, and fills the cases by a simple turn of the small handle, by which one cylindrical tube empties, while the same motion fills a similar receptacle, which is alternately discharged and replenished as long as the conical bason above contains gunpowder.

When filled, they are taken out singly, and the powder shaken down by a few smart blows against the table, and passed through the gauge of the diameter of the bore of the piece .74 inch for musket, and .65 inch for fuzil. The end of the paper projecting above the powder, is compressed and the edges folded in an oblique direction from the powder, to one-third of the breadth of the upper edge of the paper on the same side, the projecting part so folded is turned down close to the powder, the folds of the edges next the powder.

To Bundle Ball Cartridges.

In bundling cartridges 2 forms of paper are requisite, viz. the wrapper and the slip. The slip is laid on the table, five cartridges are laid on it, placing the ball of one cartridge opposite the folded end of another, five more are laid on these, placing the balls alternately as before, the slip is then folded round and secured, with two clove hitches of country twine, one at each end of the bundle close to the balls. The bundle is then placed on the wrapper, which is neatly folded round and secured with country twine, going once round each way, crossing in the centre.

One sheet of paper will cut

Wrappers—Musket	4
,, Fuzil	6
Slips—Musket	8
,, Fuzil	10

The slips cut off in making cartridges are to be used in bundling.

Blank cartridges are seldom packed in wrappers, slips only being used, as they are generally made up by Corps, and ball cartridges in Arsenals.

Small arm cartridges are carried in the field in barrels or boxes containing 500 musket or 700 fuzil each, and slung over bullocks, the same as powder barrels. The boxes are covered with wax-cloth and gunny, and marked with the nature and number of rounds of ammunition.

Articles required.

Machine filling Cartridges.—	Boxes filling Cartridges.
Formers.	Gauges.
Mallets.	Melting pot.
Knives.	Dipping ladle.
Scissors.	Moulds.
Table.	Clippers for balls.

CARTRIDGES.

ORDNANCE.

For Light Field Ordnance, are made of serge, either white or colored, the latter not being so liable to be destroyed by insects, is preferable. They are cut to fit the bore of the gun or chamber of the howitzer, by a flat wooden former, one and half diameter of the bore or chamber, the end that forms the bottom of the cartridge, is divided into two points, by which the bottom of the cartridge is in four parts, and when sewn forms a hemispherical bottom.

For Heavy Field or Garrison Ordnance, they are made of tent cloth, and are cut out by a former, one and half diameter of gun, one end being hemispherical.

The difference between the diameter of the charge and chamber should be very small. This is not sufficiently attended to, when this difference is considerable, a great quantity of the fluid is ignited before the projectile is moved.

The cartridge should always be of sufficient length to be placed under the vent, and to leave no space between the charge and projectile, or the range will be much diminished.

Dimensions of formers and quantity of Serge or Cloth required for making Cartridges.

	Former.				100 each.		
	Length.		Breadth.		If of Cloth Vizagapatam.	If of Serge White Broad.	If of Serge Coloured Narrow.
	ins	ths	ins	ths	yards.	yards.	yards.
24 Pounder......	20	0	8	2	26	32¼	37
18 „	16	0	7	5	24	28¾	34
12 „	14	0	6	6	22	16	18
9 „	8	0	6	0	16	14¾	16
6 „	8	0	5	2	14	13	14½
3 „	6	0	4	1	0	0	0
24 Howitzer........	8	0	0	0	0	0	0
12 „	8	0	0	0	0	0	0

In making cartridges the serge or cloth is placed double, and the former on it, the cartridge is marked with charcoal or lamp black, round the former, ¼ of an inch being allowed for sewing. They are sewed with cotton thread, the stitches to be close and regular, they are then turned and ready for filling.

The charge being either weighed or measured, is put in the bag by a funnel, the top of the bag is then grasped with the left hand, and several smart blows given with the edge of the right hand, all round the bag to settle the powder, the bag is then tied with a double hitch of country twine.

Cartridges for Light Field guns are always carried filled, with heavy Field Ordnance, they are carried empty, and filled as required.

Quantity of Powder used in filling Cartridges.

	Service Charge.		Proof 1200 yards.		Proof 1400 yards.		Proof of Ordnance.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Iron Gun 24 Pdr..	8	0	6	11	6	7	18	0
,, ,, 18 ,,	6	0	5	0	4	13	15	0
,, ,, 12 ,,	4	0	3	6	3	4	12	0
Brass ,, 9 ,,	2	4	1	14	1	13	3	8
,, ,, 6 ,,	1	8	1	4	1	3	2	0
,, ,, 3 ,,	0	12	0	10	0	9¼	1	0
,, Howr. 24 ,,	2	0	1	11	1	10	3	0
,, ,, 12 ,,	1	4	0	14	0	13	1	8

N. B.—At 1200 yards proof ⅙ is deducted and at 1400 yards ⅕.

Articles required.

Formers.	Measures.
Scissors.	Funnel.
Needles.	Scales and Weights.
Thimbles.	Cup for containing marking ink.

FUZES.

Fuzes are wooden tubes made of well seasoned beech, decreasing in size from the head downwards, with a cylindrical cavity through the centre, from the large end, to within about half an inch from the small end, the head or large end is made in the shape of a bowl and is called the cup.

When turned down to the proper size, and while in the lathe it is graduated or divided into divisions of two-tenths of an inch each, from the bottom of the cup to the bottom of the cylindrical cavity, by means of an instrument for that purpose, the fuze is then taken out, the small end fixed in a chuck, bored with the auger, and the cup formed with an instrument made for that purpose.

Wood has been found better than metal and can with a rasp be reduced to any size. Metal is apt to be corroded by the composition.

The bottom or small end is left solid for two reasons—1st, that the composition may not be exposed to the influence of the atmosphere—2d, that there may be a hard substance to drive against, so as to get the composition to a consistency. The cavity down the centre is filled with composition, which ignites from the flame of the charge when fired, and communicates the fire to the powder in the shell, and causes its explosion at the desired moment.

Fuze Composition.

Saltpetre.	35	parts.
Sulphur......................	12	„
Charcoal.....................	3	„
Total....	50	„

The fresher the charcoal the better will be the composition.

In mixing this composition, the saltpetre is rolled 3 hours by itself, the sulphur is mixed with it, and rolled two hours, the charcoal is then put in and well mixed with the hands, and the whole moistened with clean water, and rolled 3 hours more. The composition is sufficiently mixed, when any particles of saltpetre or sulphur cannot be discerned. After being dried in the sun it is again put in the mixing box, reduced to a fine dry powder, and passed through sieves.

To drive Fuzes.

The fuzes being fixed in a block (which holds 9) take a ladleful of composition, and put it into each fuze, place the drift over it, and give it the regular number of blows with a mallet according to the size of the fuze (20 to the large and 15 to the small) at the same time turning the drift with the finger and thumb, when another ladleful of composition, is put in each fuze, which must be carefully driven the same as before, continuing one ladleful at a time, till the cavities in the fuzes are filled to one-tenth of an inch from the top, when 2 strands of quickmatch are inserted crosswise, and half a ladle of composition driven over them. The greatest care should be taken in driving fuzes, to give the regular number of blows, and in as uniform a manner as possible, and that each ladleful of composition may be alike, or the effect of the shell cannot be depended on. The composition when driven should be quite dry.

Each fuze is marked with the initials of the driver, and the year when drove.

All fuzes should burn equal lengths in equal times, and are made to burn one inch in five seconds.

Capping Fuzes.

To cap common fuzes, the quick match, fixed in the fuze by the driver, is turned down into the cup, which is then filled with dry mealed powder, over this is placed a circular piece of paper, of the size of the cup, these pieces are cut out with a stamp or cutter, similar to the wad cutter of a fowling piece, this is again covered with a large piece, indented all round, and is pasted outside as low as the composition mark, and when dry, dipped in kitt, (care must be taken in dipping) that the cup of the fuze only is inserted, or as far as the composition mark, and also, not to commence till the froth, which rises on the kitt on first boiling has subsided. With spherical case shot fuzes, when the match is turned into the cup, it is filled with a paste of mealed powder and spirits of wine, then a strand of quickmatch is worked through the four cuts, in the cup of the fuze crossways, and afterwards finished in the same manner as common fuzes.

The difference between fuzes for common shells, and spherical case shot, is only in the priming, in the latter spirits of wine is mixed with the mealed powder and forms a paste. In common shells the priming is dry mealed powder. The cause of this difference is, the low angles at which spherical case shot are thrown, and the length of the gun; if the priming was dry it would fall out in putting the shell home. This cannot happen with mortars, as they are always fired at high angles.

Articles required.

For turning and marking Fuzes.

- Lathe.
- Instruments Fuze, setts
- Chisels.
- Gauges.
- Stamps for marking.

For driving Fuzes.

- Boxes composition.
- Blocks.
- Ladles Copper.
- Mallets.
- Drifts tipped with brass for driving Fuzes.
- Saws Fuze.
- Pendulum.

For Capping Fuzes.

- Boxes mealed powder.
- Pans copper.
- ,, Iron or Pitch kettle.
- Knives.
- Scissors.
- Pots, paste,
- Brushes.
- Cutters.
- Mallets.

TABLE OF FUZES.

	Weight of Fuze.				Composition one Mixing.							Length.			Diameter.						Quick Match.			Driving.											
															Outside.									Ladle.		Mal-let.		1st Drift.		2d Drift.		3d Drift.			
	Empty.		Composition in one.		Saltpetre.	Sulphur.	Charcoal.	Total.	Men employed.	Hours mixing.	Will fill.	Of wood.	Of composition.		Head.		Bottom.		Composition.		Length.	Threads.	A skein will cap.	Composition in each.	Blows to each.	Weight of		Length.	Diameter.	Length.	Diameter.	Length.	Diameter.	Diameter of boring auger.	A man will drive in a day.
	oz.	drs.	oz.	drs.	lbs.	lbs.	lbs.	lbs.	No.	No.	No.	ins.	ins.	ths.	ins.	ths.	ins.	ths.	ins.	ths.	ins.	No.	No.	drs.	No.	lbs.	oz.	ins.	ths.	ins.	ths.	ins.	ths.	ths.	No.
Com. 13 In.	5	9	1	2	35	12	3	50	8	8	711	6	5	0	2	0	1	5	0	4	3	2	70	1.5	20	1	8	7	3.5	5	3.5	3	3.5	4	60
„ 10 „	3	10	1	2	35	12	3	50	8	8	711	6	5	0	1	7	1	2	0	4	3	2	80	1.5	20	1	8	7	3.5	5	3.5	3	3.5	4	60
„ 8 „	2	7	1	2	35	12	3	50	8	8	711	6	5	0	1	3	0	9	0	4	3	2	90	1.5	20	1	8	7	3.5	5	3.5	3	3.5	4	60
„ 5½ „	0	13	0	6	35	12	3	50	8	8	2133	5	4	0	1	0	0	7	0	5	2	2	120	.5	15	0	14	6	2	4.5	2	3	2	2.5	120
„ 4⅖ „	0	12	0	5	35	12	3	50	8	8	2560	4	3	0	0	9	0	7	0	5	2	2	120	.5	15	0	14	4.5	2	3.5	2	3	2	2.5	150
S. Case 8 „	0	10	0	6	35	12	3	50	8	8	2133	2	1	5	1	3	0	9	0	4	3	2	90	1.5	20	1	0	3.5	3.5	2.5	3.5	0	0	4	120
„ 5½ „	0	95	0	2	35	12	3	50	8	8	6400	2	1	5	0	95	0	8	0	2.5	2	2	120	.5	15	0	14	3.5	2	2.5	2	0	0	2.5	150

KITT OR DAMMER.

Is a composition made of,

Resin	7 parts.
Pitch	2 do.
Wax	2 do.

These articles are put together in an iron pot and melted, when the froth which arises on first boiling has subsided, it is ready for dipping fuzes. It may be used in this state for covering the fuze holes of carcasses and fireballs, or when cold to put round fuze holes, to prevent the admission of air after fixing the fuze. It must be kept in water, and when required for use, drawn out like cobblers wax until soft enough, care being taken, that the part to which it is applied is kept perfectly dry, although the hands may be wet.

Articles required.

Kettle pitch.
Spatula.
Bucket water.

LIGHTS BLUE.

ARE USED ON SERVICE AS SIGNALS.

Composition for blue lights.

No. 1.	Saltpetre	9 lbs.
	Sulphur	2 do.
	Arsenic	⅜ do.
	Antimony	1 do.
No. 2.	Saltpetre refined	7 lbs.
	Sulphur	1¾ do.
	Red orpiment	½ do.

The ingredients are pulverized and well mixed, with the roller in a mixing box, and passed 3 times through a hair sieve, the brilliancy of this light depends upon the purity, and thorough incorporation of the several ingredients. The cups in which the composition is placed, are from 5 to 7 inches in diameter, and 1½ to 2 inches deep and are made of burnt clay. The composition being placed in a wooden box and moistened with clean water, the cup is taken in one hand, pressing the composition on it, which is smoothed with a clean board, a little mealed powder dredged over the top. Two strands of quickmatch are placed across each other on the top, and a piece of cartridge paper put over the whole, and pasted underneath the cup, over this is pasted a covering of portfire paper, which is also pasted under the cup. When dry the blue light is ready for use, and will burn from 1 to 2 minutes.

Articles required.

Table.	Box composition.
Mixing box.	do. dredging.
Roller.	Paste pot and brush.
Scraper.	A small board for smoothing composition.
Sieve.	
Scissors.	Gibbet for burning on trial.
Knife.	

MATCH QUICK.

Quick match is composed of cotton thread, soaked in mealed powder and spirits of wine. It is a very necessary article, and is used for priming mortars, quickmatching fuzes, carcasses, light balls and filling tubes.

Quick match composition.

Cotton thread................	¼ lbs.
Mealed powder...............	3 do.
Spirits of wine..............	3 quarts.

A skein of thread is wound into balls, some of 2, 3 and 4 threads each, as many balls as will make the number of threads required for the match, are wound into 1 weighing 4 ounces, it is then unwound into a pan, in which a portion of the spirits of wine and mealed powder have been mixed, taking care to place the thread so as not to ravel, when reeled on the frame after boiling, the end of the match is made fast to a piece of wood, and the remaining part of the mealed powder is strewed over the thread, with the spirits of wine, the thread is then pressed lightly with the hands, until the ingredients are thoroughly mixed, the cover which is made to fit close, is then put on, and the pan placed over a slow fire, and kept simmering until the liquor is nearly evaporated, which will be in about 21 minutes, the pan is then taken off, and the match reeled upon a frame, passing at the same time through a man's hand, full of mealed powder moistened with the liquor, remaining after the boiling. Mealed powder is then sifted over the match, which is put out in the sun to dry, and afterwards made into skeins of 20 strands each, by tying them together at one side of the frame, and cutting off the other side with a knife, tied up in paper, and finally put into boxes.

Articles required.

Copper pans.
Reel frame and stand for drying.
Tin Quarts.
Copper shovels or ladles.
Boxes for mealed powder.
Sifting table.

MATCH COTTON.

Cotton or slow match is made of coarse cotton thread, twisted into a rope of two or three inches in circumference, but not so hard as other kinds of cotton rope, the only preparation required afterwards is sewing the strands together, to prevent their spreading out by the explosion of the piece when fired. Each skein is made up in a roll and contains from 15 to 20 yards of match, weighing from 3½ to 5 pounds, it is used to keep a light, so as to be prepared to fire at all times, and occasionally to fire guns instead of portfires, one foot burning about an hour.

With light field guns, a portion of match is carried in the match box on the left side of the carriages, and is always kept burning on service, for the purpose of lighting portfires. The match box is divided in the centre, one half being lined with tin, with several holes in it, in this part the lighted end of the match is kept, the other is filled with match neatly folded.

With heavy ordnance cotton match is generally used for firing, about two yards is attached to a linstock, one end being kept fixed in the claws, with 6 or 7 inches hanging clear, the other end is twisted round the stock and made fast.

Cotton match is supplied to the Arsenals by the Commissariat, and afterwards sewn by the Store Department.

Articles required.

Needles, thimbles, scissors.

PASTE.

For Laboratory purposes is made from good flour, mixed with clean water, but not too thin, this is poured into a pan with boiling water in it, stirring the mixture all the time, and until it is sufficiently boiled. A small quantity of copperas, verdigris, or neem juice* may be put in the boiling water, which will generally prevent insects eating it after its application. The paste will be much stronger if conjee-water is used.

Articles required.

- Pan.
- Chattie.
- Spatula.
- Tub for paste.

PORTFIRES.

A portfire is a cylindrical tube of paper, about 16 inches in length, filled with composition, and used to fire the priming of pieces of ordnance, and burns about 16 minutes, the diameter of the case is $\frac{5}{10}$ and the composition $\frac{4}{10}$ of an inch.

A portfire will burn for a short time under water, no rain ought to affect it.

Portfires give a powerful fire, and are well calculated for firing ordnance with rapidity, but at night the strong light they give is objectionable, it cannot be concealed, and consequently it serves as a good mark for the enemy's fire.

Composition for filling portfires.

Saltpetre refined	....	44	parts.
Sulphur do.	....	14	do.
Charcoal do.	....	1	do.
Total	......	59	do.

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* Its Malabar name is Vapum marrum, and is generally known amongst Europeans, by its Portuguese name of Margosa tree.

The above composition is mixed as follows :—

The saltpetre is ground by itself for an hour and a half, the sulphur is mixed with it and ground for one hour, the charcoal is then put in, well mixed with the hands, the whole moistened with clear water, and ground one hour more. It is properly mixed, when no particles of saltpetre or sulphur are discernable.

To Roll Portfire Cases.

Place an open sheet of paper on the table, with the longest side to the edge, paste it thinly over, and double down ⅓ of the sheet and paste that part again, the rolling stick must then be put between the two folds of the paper at the double, giving one turn with the hands and then placing the rolling board, the whole is rolled up, and the rolling continued until the case is firm and smooth, it is then tried in the gauge, and if too small partly unrolled, and a strip of paper put in ; if too large a little of the paper must be cut away, the case is again put under the rolling board, and when smooth, taken off the stick, the ends cut straight with the knife and cutting stick, and pasted inside, when dry the case is marked with date, and name of person who rolled it.

To Drive Portfires.

When the case is properly dry one end is pared down with a knife and turned in to form a bottom, the setting in drift is put into the case which is then placed in the brass mould, and the whole put into the block, and firmly fixed by the screws, the setting in drift is withdrawn, and the saveall placed on the mould ; a ladle full of composition is put in, and driven down with 20 blows of the mallet—until the case is full—it is then taken out of the mould, the top neatly pared off and marked with the date, place and persons' name who drove it. Care must be taken that the same quantity of composition is in the ladle each time, to ensure uniformity ; there are 3 drifts of different lengths, and are used in succession as the composition rises in the case.

Portfires are packed in bundles of 10 each, having a wrapper at each end and one in the centre.

Articles required to roll Portfire Cases.

Table.
Paste-pots.
Brushes.
Rolling boards.
Rollers.
Pasting rods.
Cutting sticks.
Knives.
Gauges.

Articles required to fill Portfire Cases.

Brass moulds.
Wooden blocks.
Copper ladles.
Steel drifts of sizes tipped with copper

Wooden mallets.
Iron setters.
Iron end openers.
Knives.
Composition boxes.

TABLE OF PORTFIRES.

WEIGHT OF		Case empty.	oz.	2
			drs.	6
		Composition in one.	oz.	3
			drs.	12
		A bundle or ten	lbs.	3
		Drove and packed	oz.	4
Composition one mixing.		Saltpetre.	lbs.	44
		Sulphur.	lbs.	14
		Charcoal.	lbs.	1
		Total.	lbs.	59
Length.		Empty.	ins.	21
		Drove.	in.	16
			ths.	5
Diameter.		Case	ths.	8
		Composition.	ths.	4
		Paper in one case.	sheets	1.25
DRIVING.	LADLE.	Composition in one.	drs.	2
		Blows to each.	No.	20
		Will fill one portfire.	No.	30
		Weight of Mallet.	lbs.	2
			oz.	0
DRIFTS.	1st.	Length.	in.	24
		Diameter.	ths.	3.5
	2d.	Length.	ins.	18
		Diameter.	ths.	3.5
	3d.	Length.	ins.	12
		Diameter.	ths.	3.5
		Time of Burning.	ins.	16
		A man will drive in a day.	No.	40

Rockets Signal.

These are the only rockets now made up in Laboratories for Service, they consist of Cylindrical Cases of paper filled with a composition of certain combustible ingredients, which being tied to a stick and fired, mount into the air and then burst, they are used for making and repeating signals.

To Roll Rocket Cases.

The paper is first cut to the proper size, if for 1 lb. rockets a sheet of portfire paper is divided in two at the fold or double of the sheet, for ½ pound it is divided in two the contrary way.

A piece of paper is laid on the table and pasted, this is rolled on the former, with the rolling board, another piece is then added, and after being pasted is rolled over the other and as many pieces used as will bring it up to the proper size, which is ascertained by a gauge, if it is not, it is partly unrolled and a slip of paper put in if too small, and if too large a portion is cut off, always cutting the end of the paper in a sloping direction, the base of the slope part being equal to the exterior circumference of the case, when rolled one end of the case is choked, which is done by putting the nipple into the end of the former, and the choking line or bridle put round it, the case is then turned backwards and forwards, until the cavity formed by the nipple is filled up, the choke is then secured with a clove hitch of double twine and pasted, the end at the choke is cut square at one diameter from the choke.

The Wooden former has a hole bored at the end to admit the nipple, the diameter of the latter being equal to the diameter of the bottom of the spindle. If a press is used the case is rolled on a brass former, and is much firmer, as more weight can be applied than with the rolling board.

General Table of Signal Rockets.

DIMENSIONS.			1lb.	½lb.
			inch.	inch.
Case		Length	12.67	10.05
		Exterior diameter	1.69	1.34
		Interior „	1.214	.961
Heading.	Cylinder	Diameter	2.25	1.79
		Length	3.38	2.68
	Cone	Diameter	2.25	1.79
		Length	3.38	2.68

Composition for Rockets.

Saltpetre refined	lbs.	4
Sulphur	„	1
Charcoal	„	1½

The saltpetre is fast put into the mixing box, and ground for about 1½ hour, the sulphur is then mixed with it, and are ground together for one hour, the charcoal being then put in, the whole is damped with clear water, and well mixed by being rubbed through the hands, rolled with the roller one hour, and passed three or four times through a hair sieve; previous to driving, the composition is moistened with spirits of wine.

To Drive Rockets.

When dry, the case is driven tightly into the brass mould, with the first hollow drift, a ladleful of composition is put in and driven with 25 blows, moving the drift at each blow, and so continue till the composition is ⅓ the height of the spindle, when it will admit the second hollow drift, this drift is used until the composition is equal to ⅔ of height of spindle, when the third hollow drift is used, until the composition covers the top of the spindle or equal to 3⅓ diameters, the solid drift is then applied and one diameter of solid composition is driven on the spindle, and over this prepared clay ⅕th diameter, the driving is then complete, and the rocket is taken out of the mould, and ready for finishing, care must be taken when using the hollow drifts, that the hollow part is kept clean with a brass pricker.

Two hollow drifts only are used in driving half pound rockets. If the case is too high for the mould, rub a little brown soap on the exterior of the case, if too low, add a slip of paper, so that the case may fit tight in the mould, for if it does not, the force of driving would burst the interior of the case, and sometimes the whole thickness of it. The clay for rockets should be free from gravel or grit, well dried, pounded, and sifted through a hair sieve.

Dimensions of Moulds, Spindles and Drifts for pound and half pound Rockets.

		1 lb.	½ lb.
Exterior.	Length of Mould....	14 inches.	11½ inches
	Diameter at top......	3.2 „	2.3 „
	Diameter at bottom.	3.9 „	3.0 „
Interior.	Length of Mould....	10.5 „	8.5 „
	Diameter............	1.7 „	1.34 „
1st Drift.	Length.............	12.7 „	9.4 „
	Diameter............	1.1 „	.9 „
	Hollow.............	6.5 „	5.4 „
2d Drift.	Length.............	10 „	7.1 „
	Diameter............	1.1 „	.9 „
	Hollow.............	5.7 „	2.8 „
3d Drift.	Length.............	7.5 „	0 „
	Diameter............	1.1 „	0 „
	Hollow.............	3.4 „	0 „
Solid Drift.	Length.............	6.8 „	4. „
	Diameter............	1.1 „	.9 „
Spindle.	Diameter top........	.2 „	.2 „
	Diameter middle....	.35 „	.3 „
	Diameter bottom....	.5 „	.4 „
	Length.............	6.4 „	5.2 „

Stars for Rockets.

Saltpetre....................	2 lbs.
Sulphur........................	½ „
Antimony......................	½ „
Mealed powder.................	⅛ „
Isinglass.......................	1/16 „
Spirits of wine, pints...........	⅛ „
Vinegar........................	⅛ „

The Isinglass is first dissolved in vinegar, by simmering it over a clear fire, and the spirits of wine added when it is perfectly dissolved; the other ingredients are mixed with the roller, as in other compositions, and passed three times through a hair sieve, and by degrees to the liquid, which will form a thick paste, the stars are made into their proper size and shape in a mould for that purpose, which is done by dipping them into the composition till full, the stars are then forced out into a tray, with mealed powder dusted on the bottom, when the tray is full, mealed powder is dredged over them, they are put in the sun to dry, and are ready for use.

To finish Rockets.

That portion of the case above the clay, is cut off, and at the height of the composition, the case is cut half through, and the paper taken off so as to admit a cylinder of paper, the exterior diameter of which is equal to that of the case, this cylinder contains the stars, and is firmly fixed to the case with glue and a slip of paper pasted round the joint; sometimes the cylinder has its interior diameter equal to the exterior diameter of the case, and fixed on the case without cutting any of it away, but if the rocket is wanted with more stars than the other cylinders will hold, the cylinder is made much larger and a collar of light wood glued on the case, having its exterior diameter, equal to interior diameter of the cylinder, which is carefully glued to the collar, a slip of paper being fixed round the joint in all cases; a hole is bored through the clay to the composition, before the cylinder is fixed on the case; a ladle full of mealed powder is put in the cylinder for igniting the stars, then the stars 36 in number, for a 1-lb. rocket, 4 in a layer, each star is a quarter of a circle, equal to the interior of the cylinder, in the half pound twenty-two round stars, four and a half in each layer, the half star being in the centre. Over the top of the cylinder is placed a circular piece of paper, and over this with its edges fringed a larger piece, the fringed ends being pasted on the cylinder, a slip of paper is then pasted round the cylinder and over the edges to keep them down, a cone of double paper with the edges fringed and pasted, is fixed on the cylinder, over the fringe is pasted a slip of blue paper, the rocket is then put away in a box upright to dry, when dried, the rocket is primed with mealed powder moistened with spirits of wine, with which the vent at the choke is filled, over the priming a circular piece of paper is pasted with fringed edges, secured with a slip of blue paper. The rocket is then tied to the stick in the following manner, on the flat side of the stick, at the thick end, make a groove equal to the length of the body of the rocket below the cylinder, in this groove lay the rocket, and on the back of the stick opposite the choke or neck, cut a notch, and also one near the thick end, at these two places the rocket is tied to the stick with strong twine, glueing the twine after tying.

Great nicety is required in the size and weight of sticks, they should be made of light dry wood, and to ensure the rise and proper direction of rockets, they should balance on the edge of a knife at the distances in the following table.

The following are the dimensions of deal wood rocket sticks, and distance of poise from the cone.

Nature.	Length of stick.		Breadth at the top	Thickness at the top.	Square at the bottom	Poise of rocket from point of cone.
	feet.	ins.	inches.	inches.	inches	inches.
1-lb.	8	2	.80	.725	.375	25.0
½-lb.	6	6	.70	.50	.250	22.5

Articles required for rolling Rocket Cases.

1 lb. ½ lb.
Former { length 16 in.—dia. 1·2 in.—length 14 in.—dia. 1· in.
Former { handle 4 „ — „ 1·5 „ — „ 4 „ — „ 1·5 „
Cylinder or Gauge „ 1·7 „ „ 1·34 „
Rolling Board.
Press ———— 1.2 square ———— 1.1 square
Knife.
Cutting Stick.
Paste Tub and Brush:
Nipple.
Bridle for choking

Articles required for mixing Composition.

Mixing Box.
Roller.
Ladle.
Brush.
Hair sieve.

Articles required for driving Rockets.

	1-lb.	½-lb.
Mould with bottom and spindle	1	1
Drifts hollow	3	2
„ solid	1	1
Pricker to clean drifts	1	1
Box and composition	1	1
Ladle copper length one and a half diameter, exterior diameter equal to interior diameter of case, contains	5 drs.	3 drs.
Mallet weight	3½lbs.	2 lbs.
Block wood, to hold mould	1	1

Articles required for making Stars.

Table.
Glazed earthen ware pan
Roller.
Mixing box.
Mould.
Tray.
Dredging box.
Shovel
Tin ladle.
Brass pricker.

SHELLS COMMON.

Mode of preparing for Service.

After the shells are gauged and examined, as to their dimensions and weight, they must be well scraped out and the iron pin at the bottom of the inside driven down or broken off, they are then to be hammered all over to knock off the scales, and discover flaws, and no hole in the large shells is allowed more than three quarters of an inch deep. An empty fuze is then driven into the fuze hole, and the shell suspended in a tub of water, in such a manner as to be covered by the latter, but care must be taken that it does not run into the fuze, in this situation, the nose of a pair of bellows is introduced into the fuze hole, and several strong puffs given, if no bubbles rise on the water, the shell is concluded to be serviceaable.

The shells have the proper quantity of bursting powder put in them, and when required to fire buildings, a quantity of combustible matter is added, such as pieces of portfire, carcass and rocket composition, &c.

The required length of a fuze being given, it must be taken with a pair of compasses, from the line of inches and tenths on the Gunter's scale, and then applied to the fuze, counting from the upper ring under the cap, where the composition begins, the fuze must then be carefully sawn straight across, the fuzes are now generally turned down to the regulated diameter of the fuze hole and thus much trouble is saved in fitting them. All fuzes should be tried in the fuze holes of the shells, and if too large rounded off with the fuze rasp, if too small a little wax cloth should be wrapped round them, or they should be reserved for shells with smaller fuze holes.

There is a fuze knife attached to every laboratory table, by which the largest fuze can soon be reduced to any size.

Fuzes thus prepared, are then placed in the fuze holes and firmly set. A well set fuze should have nothing but the cap above the surface of the shell, as the greater the length of the fuze above it, the more it will be exposed to the action of the air, and be liable to deviate from its direction, and the greater will be the chances of injury in passing through the bore ; this of course, is of less consequence with mortars, than with howitzers and guns.

In setting the fuze,the shell should be placed on a bench or block of wood, with a concavity or grummet to receive it, or it may be placed on the ground. The setter is placed over the cup of the fuze, having a little oakum inside, the fuze is then driven in by several smart blows with a driver or mallet, taking care to move the setter, after each blow, and not to strike too hard, or the fuze will be split. When the fuze is fixed a little kitt should be placed round it, to fill up any crevices that may have been left, and so guard against accidents.

Shells thus prepared should have the range marked on them with chalk or paint to prevent mistakes.

Powder for bursting Shells.

13 Inch	lbs. 6	12 oz.
10 „	„ 2	10 „
8 „	„ 1	14 „
$5\frac{1}{2}$ „	„ 0	12 „
$4\frac{2}{5}$ „	„ 0	8 „

Articles required.

Scraper,
Bellows,
Gauge,
Hammer,
Bucket,
Saw,
Gunter's Scale,
Compasses common,
„ for Shells.
Table with knife,
Rasp,
Driver and Setter,
Vice bench.

SPHERICAL CASE SHOT.

Spherical case shot differ from common canister shot, by the balls being of lead, and loaded with a small charge of powder, which is made to explode by means of a fuze at any required distance in the same manner as any other shell. These shells are not so thick as the common ones, and have a neck at the fuze hole projecting inwards, the object of which is to keep the fuze steady, without this it could not be set firmly, in consequence of the thinness of the metal of the shell.

Table of the dimensions and weight of Spherical Case Shot, also the number of Balls in each.

NATURE OF SHELLS.	BALLS.		WEIGHT OF SHELLS.				SHELLS.		BURSTING POWDER.	
	Musket.	Fuzil or Pistol.	Empty.		Filled.		Diam.	Thickness of Metal.		
	No.	No.	lbs.	oz.	lbs.	oz.	in.	in.	oz.	drs.
8 Inch	337	525	31	0	56	6	7.85	.7	15	0
32 Pounder	176	240	14	12	27	4	6.14	.6	7	0
24 do.	130	180	11	0	20	0	5.58	.55	6	0
18 do.	90	135	8	6	14	12	5.07	.475	5	0
12 do.	63	86	5	9	10	2	4.43	.4	4	8
9 do.	41	60	4	11	7	10	4.06	.375	3	8
6 do.	27	37	3	0	4	15	3.53	.35	2	8

Mode of examining Spherical Case Shot.

1. The shells are to be well examined with a pick hammer, of a proper weight to the diameter of each nature, to find whether damaged by sand holes or other flaws.

2. They are to be well scraped inside with scrapers that can be got under the dip of the fuze hole, so that all the bore, sand, or gravel, may be cleaned out, which is to be done by rolling and shaking the shell with the fuze hole downwards. It may be taken out of large shells with a ladle that will go into the fuze hole.

3. They are to be proved with a pair of strong bellows, and water; the shell being placed under water in a tub or bucket, introduced the nose of the bellows into the fuze hole, and by blowing, the water will bubble if the shell be porous.

4. They are to be examined round the side and at the bottom, to ascertain their thickness and concentricity.

5. They are to be examined and appropriated to the respective ordnance they are found to answer. If any are too high by .03 of an inch, or too low by .03 of an inch, they are to be rejected.

6. When each shell is ascertained to be perfectly dry inside, it is to be placed with its fuze hole up, and the nose of a strong bellows (forming an angle down-wards) being introduced into it, and a few blasts given, will blow the remaining particles of sand and dust out of the shell.

7. The shells are to be classed by their fuze holes, into different numbers, viz. 1, 2, 3 and 4, those of an equal size to be packed by themselves.

8. A file is to be used occasionally to try if the metal is soft, instead of breaking the shell.

9. Each shell to be sounded, by striking them gently, as the ringing tone will be lost, should there be an imperceptible crack in it.

Method of Loading Spherical Case Shot.

The shells after being examined, and found serviceable are filled with leaden balls, when the shell is about half full, a stick of strong hard wood from 10 to 15 inches long, turned so as nearly to fill the fuze hole, is applied to pack them tight, putting in a few balls and stick alternately until the shell is well filled ; care being taken that the fuze hole is clear.

In setting spherical case shot fuzes, more precautions are required than with common shells on account of their shortness ; they are generally cut one inch in length, unless more composition is required ; when less than one inch is wanted, the scale of the fuze auger is set at the number of tenths and the surplus composition bored out, as the auger may get shorter by use, the surest method of setting it, is, by placing the end of the auger or bitt against the edge of a table or the felloe of a wheel or any other level surface, the slide with the scale attached is then pushed against the table and secured with the screw, the index on the lower slide is placed at the mark of 10-tenths and made fast, the upper slide is then placed at any number of tenths required, if it be 6-tenths the scale is pushed down, until the bevel edge of the index cuts the 6-tenths, and is made fast, then will there be 4-tenths of the auger above the upper slide.

In boring out the composition, care must be taken (particularly if only 2 or 3 tenths of fuze are required) that the fuze auger is not pressed so hard as to disarrange the whole.

Spherical case shot are fired from guns and howitzers with the full service charge, so that their velocity, on which depends the effect of the contained bullets, is nearly equal to that of round shot, at all distances beyond the reach of grape, spherical case shot will prove of essential service in firing on Troops.

More nicety and care is necessary with this species of fire than with any other.

Articles required.

Bellows.
Scrapers.
Hammer.
Gauges.
Vice bench.
Bucket.
Instruments S. C. sets.
Saw.
Driver and setter.
Funnel.
Fuze table.
Stick for packing balls.

SHOT CANISTER.

The cylindrical case, or canister is made of white iron (commonly called tin) and is equal to the diameter of round shot.

In cutting out the tin, the length is a little more than 3 diameters, and the breadth equal to the height of the canister when finished, including the clips, the two longest sides are then indented or clipped thus ∼∼∼∼∼, the clips being from 5 to 6-tenths of an inch deep, the case is formed by rolling the tin on a mandril, and soldered first at the top and bottom, then its whole length. The case is now painted outside with red lead, and when dry, the clips at one end bent inwards at right angles with the case and the iron bottom put in, with a thin layer of oakum, it is than filled with the regulated number of balls, the iron top with a cord handle, over them, and placed in the press, the screw being worked until the balls are firm and compact, the clips are then turned down on the top.

The canister is marked with white paint shewing the nature of the canister, the number and weight of each ball. The top and bottom are painted black previous to being put in.

If at any time canister shot cannot be procured, or tin for the cases, a good substitute may be made by the following methods.

On a former from ½ to ¾ of an inch less in diameter than the shot, roll a case of portfire paper, until its exterior diameter is equal to that of the shot, and its length 2 diameters and 3 inches, fit in a wooden bottom 2 inches thick, securing it with tacks, and when dry, fill it with musket or other balls fitting a top of one inch thick over them, which is also secured with tacks.

Or a bamboo equal in diameter with the shot, cut so that one end may be closed with one of its joints and filled with balls, putting a wooden bottom of 1½ or 2 inches thick over them, and securing it with tacks.

Table of Canister Shot.

ORDNANCE.	BALLS.		BOTTOMS.								CIRCUMFERENCE.	CASE.				TOTAL WEIGHT OF CANISTER.		REMARKS.
			IRON.				WOODEN.					DEPTH.						
	Weight of each.	No. in the case.	Thickness.	Diameter.	Weight.		Thickness.	Diameter.	Weight.		Circumference.	Between clips.	Total.	Weight.		Total weight of Canister.		
	oz.	No.	in.	in.	lbs	oz	in.	in.	lbs	oz	in.	in.	in.	lbs	oz	lbs	oz	
Gun 24 pdr.	3	90	,30	5,30	1	13	0	0	0	0	17,	6,5	7,5	1	0	18	4	
,, 18 ,,	3	85	,30	4,95	1	11	0	0	0	0	15,8	7,8	8,8	0	12	18	12	
,, 12 ,,	2	84	,25	4,30	1	3	0	0	0	0	13,8	6,2	7,2	0	9	12	7	
,, 9 ,,	2	60	,25	3,90	0	14	0	0	0	0	12.7	5,6	6,6	0	7½	9	4	
,, 6 ,,	2	44	,25	3,40	0	9	0	0	0	0	11,1	5,	5,8	0	6	6	4	
,, 3 ,,	1	41	,20	2,70	0	4	0	0	0	0	8,7	4,5	5,	0	3	3	1	Old pattern
Howr. 24 ,,	3	90	,30	5,30	1	13	3,0	5,30	1	0	17,	6,5	7,5	1	0	19	4	
,, 12 ,,	2	76	,25	4,30	1	3	2,50	4,30	0	14	13,8	6,5	7,	0	8½	12	8	

TUBES.

A tube is a hollow cylindrical pipe with a cup at one end from 3 to 4 inches long .19 of an inch in diameter. It is used to communicate fire to the charge of guns, instead of priming powder. Tubes are made of different materials, viz. copper, tin, paper, quills or reeds. Those made of copper or tin are not considered so good as the other kinds, being so soon rendered unserviceable by the corrosive nature of the principal ingredients of the composition, viz. Saltpetre and sulphur, and when bent or rather large for the vent they sometimes stick, instead of flying out at the explosion, and cause delay in clearing the vent, and are also more expensive.

To make Tubes.

Copper and tin tubes are made by cutting out a slip of copper or tin 4 inches long, and about .02 inch thick, this is turned over a mandrill in its longest way the edges brought together and soldered its whole length, previous to being turned, one end is divided into 4 parts, and cut .15 of an inch deep ; after soldering, these parts are turned outwards to which the cup is soldered.

Paper Tubes.

A sheet of paper is cut into slips of 3 inches in breadth, the whole length of the sheet, the slips are again cut into others 5½ inches long, they are then pasted on one side, and the tubes formed on a brass wire, with a small board with which it is rolled, till it passes through a gauge two-tenths of an inch in diameter, it is then cut at the ends to 2¾ inches in length.

The cup is made from cartridge paper, a sheet is cut into slips 17 inches long and four-tenths broad, a slip is pasted on one side, and twisted in a spiral form round the top of the tube, so as to form a cup, making the inside smooth, when dry a coat of paint is given to the outside.

Quill Tubes.

The quills are first passed through the gauge two-tenths of an inch in diameter and 3 inches long, they are then scraped with a knife to take off the coarse skin, and to make them round if required, the pith being forced out with a brass probe, they are then cut at the largest end with a seven pronged knife, thus formed they are pressed down with the thumb, and a needleful of cotton or worsted thread is worked under and over each prong alternately, ten or twelve times round, and stitched between each.

Reed Tubes.

When the reeds are first cut they are left in the sun 5 or 6 weeks to dry, they are then cut to lengths of 3⅓ inches, rejecting all that do not pass the gauge, the pith is then bored out with a pricker after which an hot iron is put through them, to burn any particles of pith that may be left in the reed, a small groove is then made round the reed ¼ of an inch from the end, and a piece of brass wire twisted round, projecting ¼ of an inch on each side to prevent it slipping down the vent.

Filling Tubes.

The composition for filling tubes is precisely the same for all natures. There are two methods for filling tubes, viz. with mealed powder and with quick match.

1st. With mealed powder.

The powder is damped with spirits of wine, not so much as to make it into paste, a little at a time is put into the tube, and rammed down with a brass drift, a little less in diameter than the bore of the tube, when full the cup is filled with the same composition and covered with a piece of bittelas, which is secured under the cup with a clove hitch, a hole is then made through the composition, the whole length of the tube and cup, the cup is then dipped in a thin mixture of mealed powder and spirits of wine.

2d. With quick match.

A piece of brass wire 4 times the length of the tube, is doubled in the middle, forming a loop, large enough to admit the quickmatch, the wire being put through the tube, a strand of match is put through the loop, and drawn double through the tube, it is cut close off at the bottom of the tube, and two-tenths left at the top. The cup is then filled as above, the end of the tube being also dipped. Reed tubes having no cup are only dipped.

Articles required.

Knife.
Scissors.
Shears.
Mandril.
Mallet.
Gauges.
Paste pot.
Soldering iron.
Pricker.
Needle.
Drift.
Rolling board.
7 Pronged knife.
Former.

WADS.

Are of two kinds, the old solid, and new grummet wad, the first is only used when firing red hot shot. the other when guns are fired at any angle below point blank ; wads are not considered necessary when guns are elevated.

The grummet wad lately introduced into the Madras service, has been long used in the royal navy. and has many advantages over the solid one, being lighter by ¾ taking up less room in package and stowage as 5 to 1, and should the wad ignite at the discharge of the piece, is not so liable to cause accidents, as the mass of ignited matter is so much less than is contained in the solid one, and by its specific gravity, it is carried to a greater distance from the muzzle.

Solid wads are made of old junk, opened out into strands, these are then wound tightly up into a ball of the size required, occasionally beating it with a mallet to bring it into shape and solid. The centre is sometimes made of oakum or coir, unravelled gunnies, &c., but these must be considered more dangerous than those made of solid junk, as the lighter the material they are composed of, the more subject to be carried back into the battery, when firing during a strong breeze.

The grummet wads are made from old rope, cut into sufficient lengths, that when untwisted will make 3 wads, each strand making one. When made, they are forced on a conical shaped wooden former, 3 feet long, 5 inches in diameter at the bottom, and 2½ inches at the top to bring them to the proper size, they are then, passed through the gauge and the ratline tied across.

Articles required.

Mallet.
Knife.
Axe.
Former.
Guage.

INSTRUMENTS GENERALLY USED IN LABORATORIES, OR ARTILLERY PURPOSES.

The-gunners instruments are few and simple.

PERPENDICULAR.

Is a common spirit level, the brass frame in which it is placed, being the most convenient shape for applying it.

It is used for taking the line of metal to lay the piece by, when this line is found the piece must be traversed to the right, or left, until the line of metal and the object fired at come in line.

With heavy guns two centres only are required to be taken, one at the base ring, and the other at the swell of the muzzle.

With mortars on account of the shortness of the piece and the eye not resting on it, three centres are taken and a chalked line drawn through them.

Most field pieces have the centres cut on them.

QUADRANT.

Quadrants are used to elevate or depress a piece of ordnance, there are two kinds the spirit and plummet ones. In the first the arc is upwards, in the second downwards. The long shank is placed in the bore on the lower surface as near as possible in the centre, and kept steady with the hands, the longer the shank is, the steadier will be the instrument, it should not however touch the shot or shell in the piece. With the spirit quadrant the index to which the level is attached is fixed to the required angle on the graduated arc, previous to its being put into the muzzle of the piece. The piece is then elevated till the bubble in the glass-level is steady and visible.

The bubble being seen and remaining without moving is sufficient, it is considered accurate enough without its being exactly in the centre of the glass tube.

The index is then parallel to the horizon or spot on which the piece is standing, and the piece will form with these parallel lines the angle at which the index is set.

With the plummet quadrant a musket ball or other weight attached to a thread, is suspended to a small hook or screw head, projecting from the centre of the graduated arc, from which, by the properties of gravity, it will hang down perpendicularly. The piece is then gradually elevated till the thread covers the required angle in the graduated arc. The piece will then form the angle denoted by the plummet line, with the spot on which it is standing or with the horizon.

TANGENT SCALE.

The tangent scale is a rod of brass, made to slide in a groove at the breech of all field guns, having engraven on it the actual length of the tangent to the different angles of elevation.

The tangent scale must be used for all elevations above three degrees; and, indeed, it is better to use it whenever the elevation is more than the line of metal. It is divided into quarters of degrees, the length of which depends upon the nature and length of the gun. When it is used, it should be drawn out till the required elevation appears just at the top of the pipe, when the screw is turned to fix the scale. The line of direction is given as before, from the trail, and the elevation from the breech by lowering it till the notches in at the top of the scale and at the swell of the muzzle coincide with the object.

Rule for calculating Tangent Scales.

The length of the gun from the hind part of base ring to swell of the muzzle is taken as a radius, and multiplied by the natural tangent of as many degrees as may be required, or, as the tangent of one degree to a radius of 1 foot is 0·2094 inches, if the distance in *feet* between the base ring and swell of the muzzle be multiplied by that number, the product will be the length of the tangent of one degree.

If there is no dispart, its length should be deducted from the *first degree*, and if it exceeds the latter the difference is taken from the second degree.

CALIBER COMPASSES.

Caliber compasses consist of 2 flat brass plates, six inches long, connected by a screw, and about 1½ inch in breadth, with a variety of tables engraved on them. The points are tipt with steel that they may not wear out.

It is the most useful instrument an Artillery officer can have, an experienced eye, cannot judge accurately of the nature of pieces of ordnance and shot, particularly when very small, and mistakes might easily arise by shot of one caliber, being sent with guns of another.

In reporting on the nature of captured ordnance and ammunition this instrument is indispensable.

To take the caliber of a gun, the legs of the instrument are made to cross each other, and placed in the bore of the piece, till the steel points touch the sides, then turn it gently round, to ascertain it is properly bored, which it will be, if the points touch the sides in the whole circumference, withdraw the instrument and inspect the plate with "*Guns*" and "*Inches*" on it, the figure that is just cut by the leg crossing it on "*Guns*" will denote the caliber of the piece relative to its shot, for instance fig. 9 will denote a 9-pounder. The number in "*Inches*" the diameter of the bore in inches, which in this case will be 4⅕ inches, each division being $\frac{2}{10}$—a straight line connecting the two steel points will be exactly 4⅕ inches.

To take the caliber of a shot or shell, open out the legs and place the projectile between them, to receive it there is a hollow part made in each leg, let the points touch the surface, move the instrument up and down to ascertain that you have taken the proper diameter; inspect that part marked "*Shot*" see which division the index cuts, the figures will shew the nature of the shot in lbs. Thus the index cutting 18 will shew that the shot is an 18-pounder and so on, the figures in the lower row are intended for the divisions in the upper row that have none.

The figure under the part marked "*Shot*" shews the diameter in inches, an 18-pounder for instance 5 inches.

CALIBER COMPASSES FOR TAKING THE THICKESS OF A SHELLS SIDE.

These are used in examining shells, the straight leg with the end bent inwards, is put into the fuze hole, and made to touch the side of the shell in any part, the compasses are closed till its fellow circular leg (both these legs are tipped with steel to prevent their wearing out) touches the outer surface of the shell, when it will be evident the side of the shell will be between the two points, to ascertain its thickness, look at the scale above, of tenths of an inch, and observe the figure cut by the index, which will indicate the thickness of the shell, in tenths of an inch, for instance, if the index cuts the figure 8, the side of the shell will be eight-tenths of an inch thick.

CALIBER COMPASSES FOR TAKING THE THICKNESS OF A SHELLS BOTTOM.

Are also used in examining shells, the straight leg is put in the fuze hole of the shell and made to press against the bottom, the compasses are then shut till stopped by the check on the curved part near the handle, by inspecting the instrument, it will be evident, the straight leg, and the index at the end of the curved leg will be in a line slide; on the scale till it touches the shells bottom externally, which alone will prevent to two points meeting, the figure on the scale cut by the index, will give the thickness of the bottom in tenths of an inch, for instance, if six, will be six-tenths of an inch thick at that part.

SEARCHER.

Is an instrument made of a wooden stave, at the end of which are eight pointed iron rods confined by a ring, which is attached to another stave, and which is called the reliever, this moves up and down, so as to bring the iron points close together, or allow them to open out so as to touch the sides of the bore of any piece of ordnance.

The use of a searcher is to ascertain the depth and position of any cavity that may be in a gun—for this purpose the reliever is pushed to the bend of the points so as to allow the searcher to enter the bore, when well in the reliever is drawn a little back, to liberate the points, the handle is then turned in all directions, so that in case of any cavity, one of the points may run into it, when this takes place the handle is marked with chalk, close to the muzzle, which will serve to shew the distance of that part, from the cavity. The reliever is then pushed forward to liberate the points—the surface of the piece at the cavity as near as can be judged must also be chalked—a single pointed searcher or fish, is then introduced, having some wax on the point, which must be run into the cavity, the wax will take the shape, which can be measured when withdrawn.

BRASS FUZE PINCERS.

Are very useful for drawing small and short fuzes such as those used with spherical case shot.

FUZE ENGINE.

This is a powerful lever used to extract fuzes from large shells, the bottom part, which is circular, is made to rest on the shell, with the head of the fuze in the centre.

Two small notches in the under part, are to receive the lugs on the shell, which keep the instrument steady.

The screw is then turned until the vice is made to embrace as much of the head of the fuze, as can be got at, and then tightly fixed on it, the upper screw is then turned, which will draw up the vice, and of course the fuze with it.

SPIKES.

There are three kinds of spikes all made of steel, and used in stopping up vents to render guns useless, the *round*, the *ragged* and *spring*. A round spike is nothing more or less, than a steel nail without a head, of a conical shape. It is driven into the vent with a hammer, and the projecting part broken off.

The ragged spike is nearly square, and has its angles cut like a file, but coarser and deeper. The points of the jags being upwards. It is driven into the vent of a gun the same way as the round spike, but it is more difficult to extract.

A spring spike has a head like that of a musket ramrod the lower part resembling an arrow. The point is driven into the vent, which presses the two springs or arrow head close to its sides—when passed through the metal into the bore both open out, and cannot be withdrawn from the outside until these springs are broken off. The spike can easily be withdrawn when a reliever is at hand, and must only be used when it is expected the gun will soon be retaken.

The other spikes are more difficult to be removed, but their extraction may be effected as follows.

Load with rather more than a third of the shots weight in powder, soak two wads in a solution of saltpetre, and when dry, place a shot between the wads, which must not be made too high, bind them together with long strands of quick match, and send the whole home on the charge, put an ounce or two of gunpowder in the copper ladle, and scatter it along the whole length of the bore, then fix a wad or turf in the muzzle of the piece, with half a portfire passed through it, by which means the gun may be easily fired off—if this does not remove the spike, repeat the experiment with an additional shot or wad.

With brass guns, a day or two previous to the experiment, scratch round the spike with a graver, and put a few drops of aqua-fortis round.

SHOT GAUGES.

There are two gauges for each shot and shell, one marked H high, through which the shot or shell should pass, and the other L low, through which they should not pass.

These gauges are made to correspond with the decrease in windage, ordered by the Board of Ordnance in September 1825, there being a minimum and maximum for each projectile.

The two gauges high and low, should be connected, by a small bolt and screw nut, that they may not be separated.

Military Pyrotechny.

fig 1
Budge Barrell
Weight 16lbs.

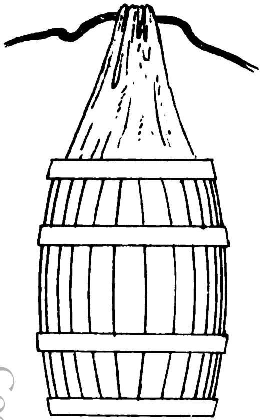


fig 2
Composition Barrell

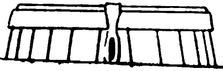
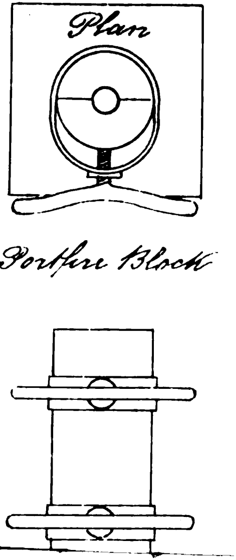
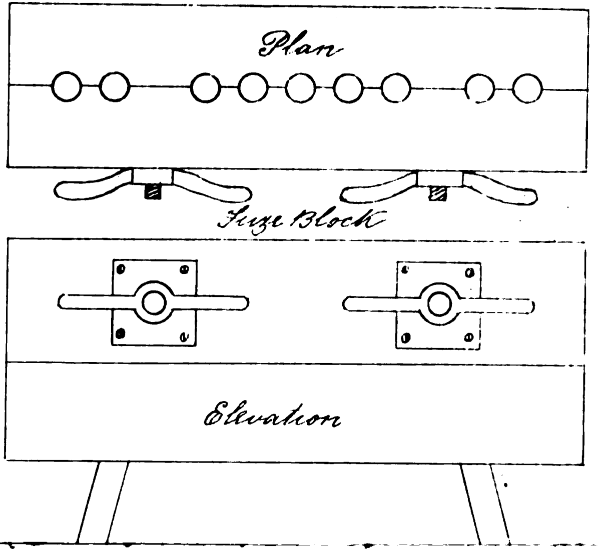


fig 3

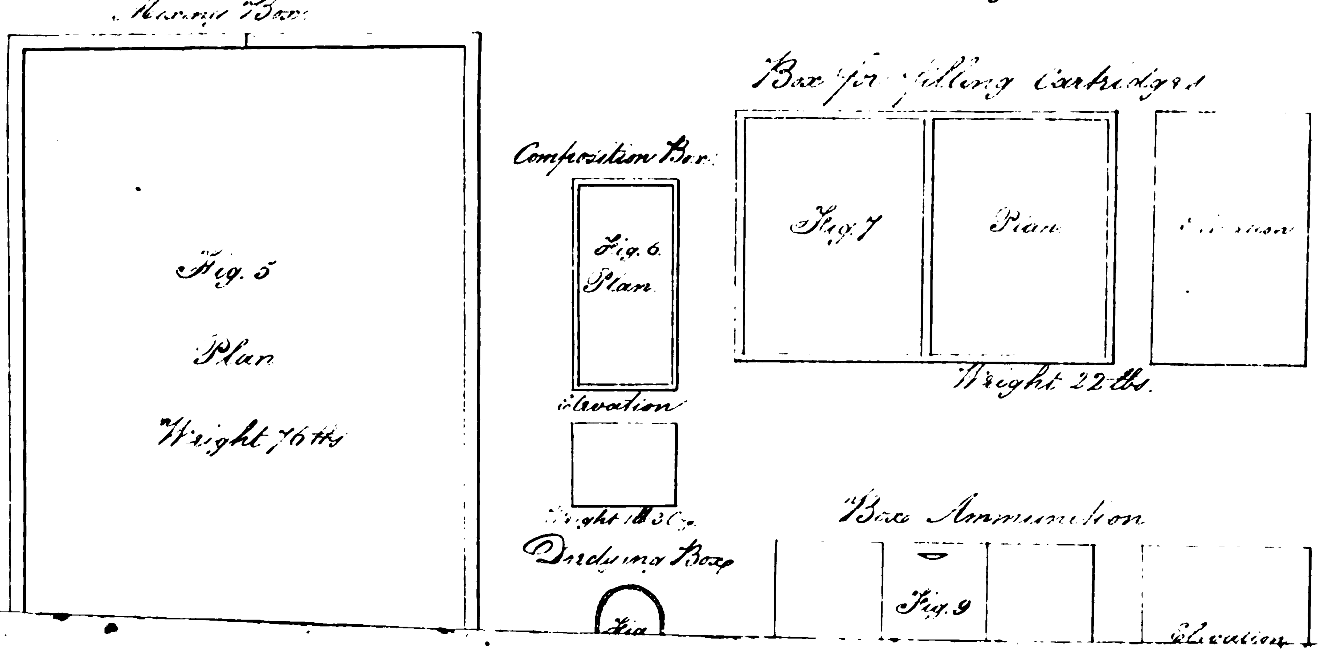


Portfire Block

fig 4



Scale 4 inches to a foot.



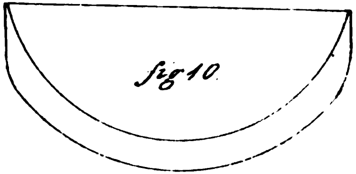
Scale 4 inches to a foot.

Military Pyrotechny.

Bottoms.

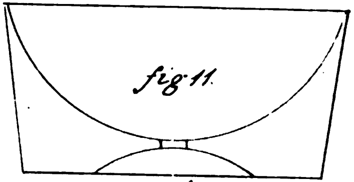
Howitzer

5½ inch



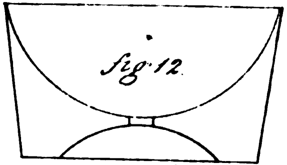
Weight 8½ oz

24 Pdr.



Weight 8½ oz

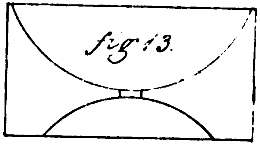
12 Pdr.



Weight 5¾ oz

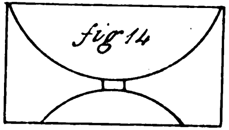
Gun

9 Pdr



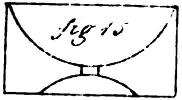
Weight 4½ oz

6 Pdr



Weight 4 oz

3 Pdr



Weight 3½ oz

Scale 4 inches to a foot.

Military Pyrotechny.

Calibre Compasses
Large

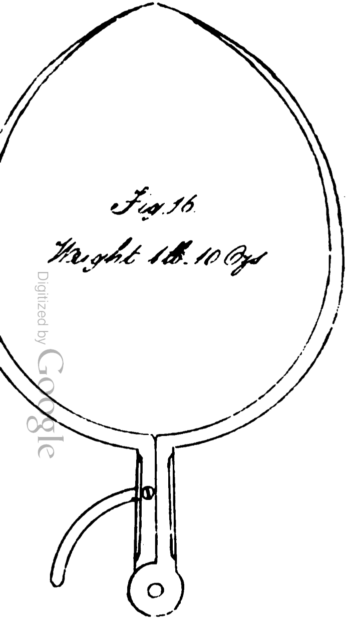


Fig. 16.

Weight 1lb. 10 Ozs

Calibre Compasses
Small

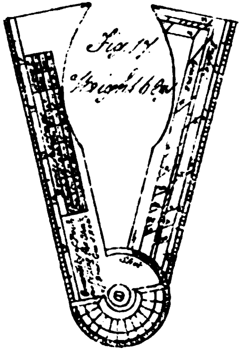


Fig. 17

Weight 16 Oz

Compasses
Common

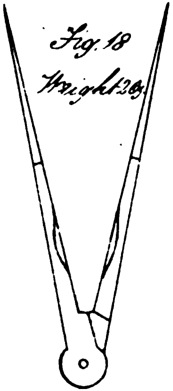


Fig. 18

Weight 2 Oz

Compasses for taking the
thickness of a Shell's bottom.

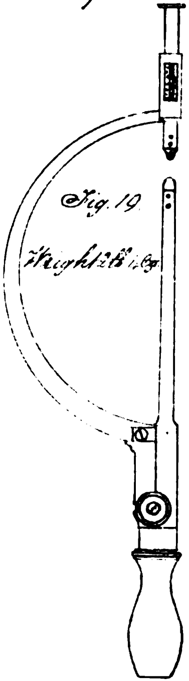


Fig. 19

Weight 2lb 1 Oz

Compasses for taking the
thickness of a Shell's side

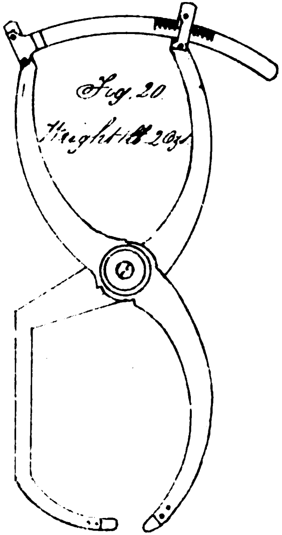


Fig. 20

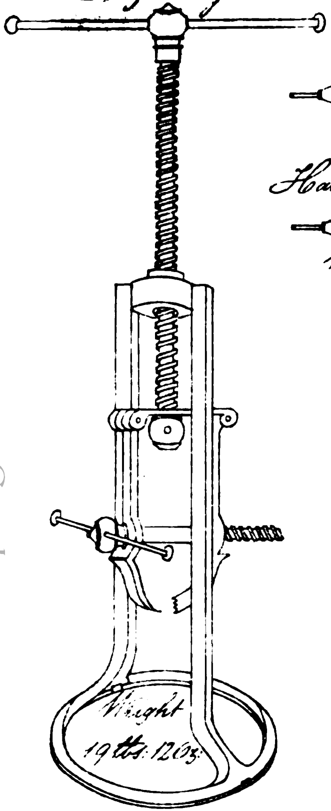
Weight 1lb 2 Ozs

Scale 3 Inches to a foot.

Military Pyrotechny.

Fig: 33

Fuze Engine



Bitt

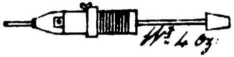


Fig: 34.

Hand Auger

Fig: 35.

Brace Auger

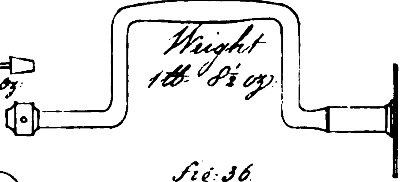
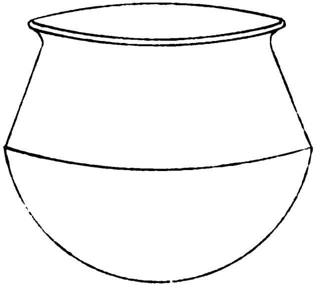
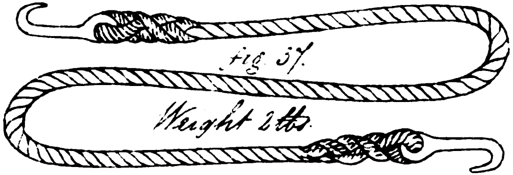


Fig: 36.

Chattie.

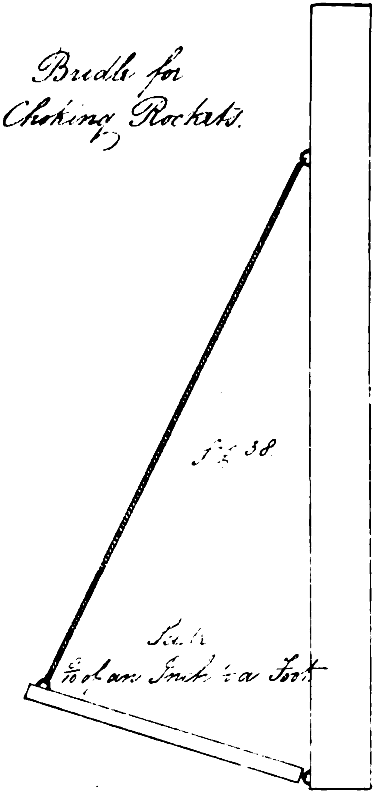


Cant Hooks.



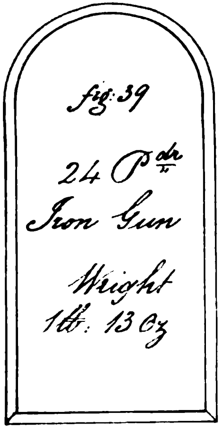
Scale 2 Inches to a Foot

Bridle for
Choking Rockets.



Scale
7/10 of an Inch to a Foot

Formers Cartridge.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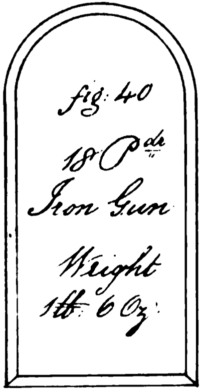
fig: 40

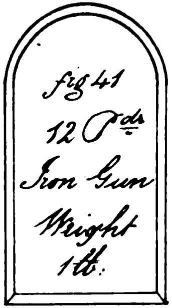
fig 41

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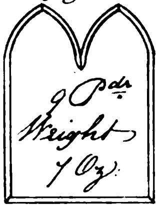
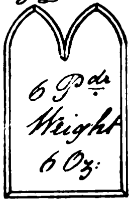


fig: 43.


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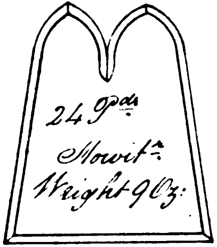

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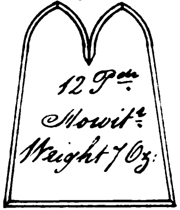

Scale 1½ Inch to a Foot.

MILITARY PYROTECHNY.

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ARTILLERY KARKHANAS.

Minute of the Commander-in-Chief.

I beg to submit to the Board copy of a letter from the Acting Commandant of Artillery, giving cover to a proposition submitted by Lieut.-Colonel Noble, C. B., of that corps, "for "attaching draught cattle to the corps of Foot Artillery, and "forming a corps of Drivers," a measure which I consider necessary to the efficiency of that arm of the service.

If the proposition is honored with the approval of government, I shall be prepared to submit the details necessary for the organization and completion of the system. The excellence of the public cattle establishment in Mysore, would seem to render it unadvisable either to reduce or alter it, but while the present mode of breeding and supply is maintained, experimental efforts may be made on a small scale without much expence, to endeavour to improve the breed of bullocks in size and weight, without deteriorating the superior qualities they now possess; but no change should, in my opinion be made in the present mode of breeding and supply, till some decided advantage is unquestionably ascertained by experiment.

If cattle are supplied to the Artillery establishment, they should be provided from the farm in Mysore, and attached permanently to the Artillery as a fixed establishment, as horses are to the Horse Brigade, but the Karkhana establishment should I think be kept up on as large a scale as practicable for the other calls of the service, and any decrease these measures may admit of, be made by reducing the numbers of hired Cattle.

(Signed) A. CAMPBELL.

FORT ST. GEORGE,
16*th May*, 1823.

TO THE ADJUTANT GENERAL OF THE ARMY.

SIR,—I have the honor to forward a paper submitted to me by Lieut.-Colonel Noble, C. B., regarding an establishment of draught cattle for the corps of Artillery, which I beg leave to recommend to the notice and attention of his Excellency the Commander-in-Chief, and should it meet his Excellency's approbation, I have to request that he will bring it to the favorable notice of the Honorable the Governor in Council for his consideration.

(Signed) T. W. FREESE, Col.
Acting Commandant of Artillery.

ARTILLERY HEAD QUARTERS,
ST. THOMAS'S MOUNT,
8TH DECEMBER, 1822.

Memorandum given by Lieut.-Colonel NOBLE, C.B. *to Colonel* FREESE, *Acting Commandant of Artillery, on the subject of attaching to the Artillery, a Corps of Drivers, and an Establishment of Draught Cattle.*

1st. I consider it an object of the greatest importance, to improve the establishment of ordnance draught cattle under this Presidency, and I am persuaded this may be done with great advantage to the public in point of economy, and to the Artillery, in point of efficiency.

2d. There is perhaps no part of our military equipment so capable of improvement, and requiring it so much, as our gun bullock establishment; it has undergone no change for the better since the Mysore war, when the draught cattle of that state fell into the hands of the Honourable Company, and that establishment has certainly not increased in efficiency, however carefully, and well it may have been managed, since the period of its transfer.

3d. There cannot be a stronger proof of the inferiority of our gun bullock establishment, than is shown by the accompanying statement of cattle required here, and under the Bengal Presidency, for the draught of similar pieces of ordnance.

4th. A reference to that statement will shew, that to move heavy guns, either iron or brass, we require more than double the number of cattle. In moving the smaller description of guns, and light carriages, the difference is not so great, but it is still considerable, and if by any means our draught cattle can be brought to any thing like the perfection of that establishment in Bengal, a great saving will arise to the public, at the same time the efficiency of the Artillery will be greatly increased.

5th. In Bengal, the carriage cattle establishment is also much superior to our's; their cattle carry each 210lbs. weight of stores, with us a bullock only carries 120lbs. weight.

6th. If our gun and carriage bullock establishment could be brought to the same state of perfection as in Bengal, there would be a saving to the public with the Hyderabad and Nagpore forces alone, in the field, of 151,740 rupees a year viz.

Hyderabad saved in draught cattle............Rs.		47208
Do. do. in carriage do..................		50580
		* 97788
Nagpore saved in draught cattle..........	23352	
Do. do. in carriage do.............	30600—	53952
Total rupees......		151740

7th. I have annexed the particulars of this calculation, that any mistakes I may have fallen into, may be corrected. I am not aware of any cause from my own experience, why the cattle under this Presidency should not equal those of the Bengal Establishment. We have the command of countries at our disposal celebrated for fine cattle, and if our own resources fail, might apply to Bengal for assistance.

8th. With all the superiority in the number of our cattle, the Madras Artillery cannot march with the Artillery of the Bengal Establishment, there have been frequent opportunities of late to make the comparison, and it has been remarked, that a Bengal iron 18 pdr. moves as expeditiously, and as easily, as one of our brass 6 pdrs.

9th. This is owing to the superiority of their cattle, and their system of management. In 1803 (as shewn by the statement) more cattle were required for their guns than at present. The advantages gained, are attributed entirely to the improved system lately adopted; and I have not the least doubt of the great advantages we should derive from the adoption of a similar system.

10th. The present establishment of cattle under this Presidency, is not only inferior to what it might be as it relates to the cattle, but it is very objectionable in system, the officers of Artillery who are chiefly interested in the efficiency of the corps, having nothing to do with the cattle

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* Not including Jaulnah Force.

till they are yoked to the guns. They have no control over the establishment, either in regard to the description of cattle fit to be admitted into the service, the care taken of them, or the mode of training them. The consequence is, when the guns cannot get on, that the Artillery officer lays the blame to a failure in the cattle, and this charge is repelled by urging a want of exertion on the part of the Artillery.

11th. A system which admits of recrimination, and uncertain responsibility is always bad, and particularly so in military affairs. The disgrace of failure, or credit of success, in a matter of such importance as the efficiency of the Artillery should be clearly attached, and no where can this responsibility be so properly placed, as in the hands of the officers of Artillery.

12th. Another disadvantage of the present system is, that the Artillery from having no cattle permanently with the corps, have not the means of practicing in time of peace, the system to be followed in time of war.—There must always be a want of confidence and harmony between the men of the Artillery and drivers of the cattle, they are strangers to each other, as they are to any system of acting together. The drivers do not in any shape belong to the Artillery branch of the service, and there are constant complaints between them and the men of the Artillery, which failing to be enquired into, and redressed by different departments in the army, leads to a great deal of trouble and discord.

13th. The condition of the drivers also, under the present system is extremely unfortunate and discouraging. They are not, by the regulations of the service, placed on the same footing as other followers of the army who are expected to go into dangers. They are not provided for in case of old age, or wounds received in the service, and under these circumstances, cannot be expected to do their duty properly; on the most common occasions there is always inconvenience from desertion of drivers, and on particular occasions, the footing on which they are placed, is likely to lead to the most serious disasters. They are not paid for risking their lives, and cannot be expected to go into action willingly.

14th. It may be an objection to the proposed system, that the cattle being attached to the Artillery will prevent their employment, as may be the case at present, in various ways for the good of the state, but there can be no objection to the employment of Artillery draught cattle, in the transport of stores from one magazine to another under circumstances not affecting the condition of the cattle. If it has the effect of injuring them, I am inclined to think it will be the most expensive way of performing the service, and that the employment of the ordinary hired draught cattle of the country would be better and cheaper.

15th. Whoever has been on service and has seen the advantage of good, or disadvantage of bad cattle, will readily admit the propriety of bringing the gun bullock establishment, to the highest state of efficiency ; when the cattle are not in that state, the Artillery becomes an annoyance to the whole camp. The troops are worn out, and fatigued, by the slow, and uncertain movements of the Artillery, while the embarassed operations of the army, gives a discouraging cast to all its undertakings.

16th. I am not aware that the system I have to propose will be attended with much more expence, than an equal number of public cattle on the Mysore establishment, nearly the same feeding, followers, and establishments now allowed to the Mysore cattle will I think be sufficient under the proposed system, which has chiefly in view the improvement of the cattle themselves and a change in their system calculated to benefit the corps of Artillery as well as the public.

17th. On the score of economy and efficiency, a change is desirable, and I shall therefore propose, that a regular corps of drivers shall be formed and added with an establishment of cattle, to the corps of Artillery, on the same principle as horses are attached to the Horse Brigade ; an arrangement, which to its other advantages, will admit of a certain reduction of gun lascars, that establishment on the maturity of the proposed plan, not being calculated upon, for the movement of the Artillery either at exercise, or in the face of an enemy.

18th. The regular corps of drivers and cattle I propose should be attached only to a certain proportion of light field ordnance formed into batteries, and fixed at the principal stations of the army. The strength of these batteries to be fixed by the number and description of ordnance, which one company of Artillery man can.

19th. The detail of the corps of drivers, and number of cattle proposed for each company of Artillery to be as follows.

1 Darogah.
4 Choudries.
80 Drivers.
160 Draught Bullocks.

20th. I consider it will only be necessary to attach cattle, and drivers to detached companies of the Artillery, and to a certain number of companies at head quarters. As the distribution of the Artillery now stands, light field batteries with drivers and cattle complete will be stationed as follows.

		Companies	*Cattle.*
Hyd. Sub. Force.	Hyderabad	2	320
	Jaulnah	1	160
	Bangalore	2	320
	Belgaum	1	160
	Bellary	1	160
	Cannanore	1	160
	Quilon	1	160
	Trichinopoly	1	160
	Masulipatam	1	160
Head Quarters of the Artillery, one Company each Battalion		3	480
		14	2240

21st. In addition to the light field batteries, I should propose to keep up one company of drivers and cattle, for the draught of the ammunition waggons of the Horse Brigade on service, and it will also be necessary to form and keep up two companies for a small siege equipment, one company to be stationed at Hyderabad, and the other at Belgaum, making altogether 17 companies of drivers, and 2720 cattle, for the service of the ordnance department.

22d. At present there are 5011 draught cattle kept up, the greater part of them belonging to the establishment in Mysore, but 2720 are all I should consider necessary to keep up for the ordnance department, and it may be a question whether or not, it is expedient in time of peace to keep up any other establishment of draught cattle; I am of opinion it is not, and that the ordinary resources of the country are sufficient in time of peace, and may be depended upon for any increase, which war may render necessary, to the draught cattle establishment.

23d. I should not consider it necessary under any circumstances, to extend the proposed system of regular drivers to the store or Commissariat Departments, great expedition or precision in driving not being required in these departments, nor are the drivers exposed to danger in the same way as the gun drivers are.

24th. Under the proposed plan, each company of Artillery, will have a complete establishment within itself for a field battery of a detailed number of guns, it will have the usual proportion of spare carriages, artificers, store, and forge carts. These latter are at present in the department of the Commissaries of Ordnance, but to carry the proposed plan properly into effect, should be transferred to the Artillery.

25th. I have not proposed any detail of ordnance to be attached to each company of Artillery, that being an arrangement likely to change with the nature of the service on which the field batteries may be employed, but I have calculated the proportion of cattle as equal to the draught of as many guns as the company could man.

26th. The light field batteries will only have attached to them the following description of guns and carriages, viz.

12 pdr. brass guns, each	8	bullocks	in yoke.
6 ,, ,, ,, ,,	6	,,	,,
5½ inch howitzer	8	,,	,,
4⅖ ,,	6	,,	,,
Waggons ammunition	6	,,	,,
Spare carriage 12 pdrs. 5½ inch howitzer	8	,,	,,
,, 6 pdrs. ,, 4¼ in.		,,	,,
Carts, store, or artificers	4	,,	,,

and the battery will be formed of any proportion of the above which can be drawn by 100 bullocks, leaving a proportion of one in six spare.

27th. The cattle under the proposed system may not at first be equal to the draught of ordnance as detailed above, and until they have reached a certain state of perfection, the guns attached to batteries will be regulated by the work the cattle can perform.

28th. I have the honor to suggest the following under the head of General Regulations, for the formation and management of the Corps of Ordnance drivers and cattle.

1st. That a corps of drivers, and an establishment of cattle shall be raised and formed for the service of the ordnance department under the Madras Presidency.

2d. The establishment to consist of 17 companies of the following strength, which will be attached to troops, companies, or divisions of Artillery, under the orders of the Commandant of Artillery, sanctioned by His Excellency the Commander-in-Chief.

Statement of Drivers and Cattle for one Company of Artillery.

	Darogah.	Choudries.	Drivers.	Cattle.
One Company of Artillery	1	4	80	160

3. The foundation of this Establishment to be taken from the public cattle Department in Mysore. The drivers who may be willing, and cattle which may be found fit for the Service, to be transferred to the Corps of Artillery.

4th. Pay and batta of the Corps of Artillery drivers fixed as follows.

	Pay Rups.	Batta per day. As.	P.	Cs.
1 Darogah................	17..............	2	5	87
1 Choudry................	12..............	1	10	40
1 Driver..................	7..............	1	2	93

5th. An allowance for stationery of 3 rups. 8 as. 0 p. is allowed to each company, and a man in each company also, is allowed to be employed, under the designation of a bullock Serjeant with a staff allowance of 10 rupees per month for the purpose of superintending the gram department, and keeping the accounts of the cattle establishment.

6th. The drivers admitted into the service not to be under the height of 5 feet 4 inches, and the age of admission to be between 18 and 22 years.

7th. The drivers to be eligible to the Pension List, under the same rules and regulations as the native army in general.

8th. The drivers to be clothed by Government, each man to receive annually, one loose blue coarse woollen cloth jacket, trimmed with red, like the horse brigade camel drivers; the darogahs, and choudries jackets to be made of cloth called aurora.

9th. The drivers to furnish under Regimental Regulations, uniform turbands, cummerbunds, and trousers, as also driving whips.

10th. The drivers to be allowed medical attendance, the same as other native followers.

11th. The corps of drivers to be subject to the rules of military discipline, and Articles of War, and not to be discharged from the service but under authority from Head Quarters.

12th The payment and mustering of the corps of drivers, and all Registers, and Records connected with them, to be regulated in form, and system, the same as the gun lascars attached to companies of Artillery.

13th. The cattle required for the service of the Artillery to be provided by the commissariat, under the same system as remount horses, not to be under the height of 12 hands, 2 inches; and the age of admission to be between 5 and 8 years.

14th. All cattle supplied for the service of the Artillery, are to be examined and passed by a committee of Artillery officers, who will certify their opinion, that the cattle are strong enough to draw ordnance and carriages in the following proportions.

Iron guns.	Bullocks in the yoke.
24 pdr	26
18 „	22
12 „	18
Brass Ordnance.	
24 pdr	18
18 „	14
12 „	10

Brass ordnance.	**Bullocks in the yoke.**
6 pdr.	6
8 inch howitzer	10
5½ ,, ,,	8
Tumbrils, or waggons	6
Artificers carts	10
Mortar ,, large	10
,, ,, medium	6
Transport carriages	20
Store, or platform carts	4

Spare Carriages.

24 pdr iron	16
24 ,, brass	12
18 ,, iron	14
18 ,, brass	10
12 ,, iron	12
12 ,, brass	8
6 ,, ,,	6
8 inch howitzer brass	8
5½ ,, ,, ,,	6
4⅖ ,, ,, ,,	4

One bullock to every six, allowed as spare to the above.

15th. Each bullock to be allowed a full sized cumley or jhool, a feeding gunney 3 feet square, also leathers for soaking gram in the proportion of 5 to each company, and a curry comb, and hand rubber allowed to each pair of cattle. These articles to be supplied when required, by the Commissariat on indents, approved and passed under proper authority.

16th. Each bullock in the field, or marching with guns to be allowed 3 seers of gram, and 7 ℔ of dry forage daily; in cantonment to be allowed 2 seers of gram, and 7℔ of dry forage: these supplies to be furnished by the Commissariat. Boosah, or curbie to be the description of dry forage to be issued when procurable—when not procurable, the description of dry forage to be regulated by the supplies of the country, and when none of any description is procurable, double the weight of green forage to be issued.

17th. The drivers and cattle are to be employed in foraging, in addition to what the Commissariat furnishes, and for this purpose, a proportion of the spare cattle will be supplied with saddles to be furnished by the Commissariat.

18th. Picketing ropes, driving and leading ropes, &c. &c. will be supplied from the ordnance stores, in the same manner as other articles required for the use of the battery. These ropes, jhools, &c. are to be carried on the march by the spare cattle.

19th. Massalls occasionally when required for the cattle, with the medicines for sick cattle, and a proportion of coarse salt (1 measure monthly) for each bullock to be supplied by the Commissariat, when there is no commissariat officer or servant to furnish the supplies mentioned in these regulations, the officer commanding the company, under the sanction of the commanding officer of the Artillery on the spot, and commanding officer of the camp will have to furnish the supplies sending his bill on honor to the commissariat officer for payment.

(Signed) JOHN NOBLE, Lt.-Col.
Commanding Horse Brigade.

Table of Draught Bullocks for Ordnance Carriages, Bengal and Madras Establishments.

	Bengal 1803.	Bengal at present.	Madras at present.
Iron ordnance 24 pounder	32	26	60
do. do. 18 do.	24	22	50
do. do. 12 do.	20	18	40
Brass ordnance 24 do.	24	18	”
do. do. 18 do.	18	14	30
do. do. 12 do.	12	10	12
do. do. 6 do.	6	6	8
do. do. 8 inch howitzer	14	10	24
do. do. 5½	10	8	12
do. do. 4⅖	6	6	8
Transport carriages	”	”	50
Tumbril ammunition	6	6	10
Mortar cart (stout)	”	6	30
Store do.	”	4	4
Spare carriages 24 pounder brass	”	12	”
do. do. 24 do. iron	”	16	40
do. do. 18 do. brass	”	10	20
do. do. 18 do. iron	”	14	30
do. do. 12 do. brass	”	8	8
do. do. 12 do. iron	”	12	24
do. do. 6 do. brass	”	6	6
do. do. 8 inch howitzer	”	8	16
do. do. 5½ do. do.	”	6	8
do. do. 4⅖ do. do.	”	4	6

Spare bullocks, both draught and carriage one to six.

Statement of Draught and Carriage Cattle Hyderabad Subsidiary Force.

Gun and carriages.		Madras.		Bengal.		
		One gun.	Total.	One gun.	Total.	Difference.
Heavy field iron gun 18 pounder	No. 2.	50	100	22	44	56
„ „ „ „ 12 „	„ 2.	40	80	18	36	44
„ „ brass howr. 5½ inch	„ 2	12	24	8	16	8
„ „ „ mortar 8 „	„ 2	30	60	10	20	40
Light field brass gun 12 pounder	„ 2	12	24	10	20	4
„ „ „ „ 6 „	„ 12	8	96	6	72	24
„ „ „ howr. 5½ inch	„ 2	12	24	8	16	8
„ „ „ „ 4½ „	„ 4	8	32	6	24	8
Transport carriages................	„ 4	50	200	20	80	120
Waggons ammunition.............	„ 36	10	360	6	216	144
Chests laboratory..................	„ 1	8	8	8	8	
Carts mortar..........................	„ 1	30	30	6	6	24
„ Artificers..........................	„ 1	10	10	8	8	2
„ Platform..........................	„ 50	4	200	4	200	
		0	1248	0	766	482
Spare one to Six...........................		0	208	0	128	80
		0	1456	0	894	562

562 Draught bullocks at 7 Rupees per month is annually..47208

To the carriage of stores attached to the above in loads of 120 lbs. per bullocks..................................2300

For do. do. at the rate of 210 lbs. per do.....1457

Difference......843

843 carriage bullocks at 5 Rupees per month is annually 50580

Total Rupees,...97788

Statement of Draught and Carriage Cattle Nagpore Subsidiary Force.

Ordnance and carriages.	Madras.		Bengal.		Difference.
	One Gun.	Total.	One gun.	Total.	
Heavy field iron gun 12 pounder 2	40	80	18	36	44
Light field brass Gun 12 „ 2	12	24	10	20	4
„ „ „ „ 6 „ 8	8	64	6	48	16
„ „ „ Howr. 5½ „ 2	12	24	8	16	8
Waggons ammunition..................23	10	230	6	138	92
Chests laboratory...................... 1	8	8	8	8	0
Carts artificers.......................... 1	10	10	8	8	2
„ Platform 15	4	60	4	60	0
Transport carriages 2	50	100	16	32	68
Carriages...........................6 pounder	8	16	6	12	4
	0	616	0	378	238
Spare one to six..............................	0	103	0	63	40
	0	719	0	441	278

278 draught bullocks at 7 Rupees per month is annually..23352

To the carriage of stores attached to the above in loads of 120 lbs. per bullock..................................1189

To the carriage of do. in loads of 210lbs. per do.......679

Difference......510

510 carriage bullocks at 5 Rupees per month is annually...30600

Total Rupees....53952

(Signed) JOHN NOBLE, Lt. Col.
Commanding Horse Artillery.

COMMISSARY GENERAL'S OFFICE.

To CAPTAIN M. H. DAVIDSON,

Deputy Assistant Commissary General.

SIR,—It being intended to attach an establishment of draught bullocks and drivers to the Foot Artillery, I enclose for your consideration copy of a communication which I have received from the acting commandant of Artillery; and I request that you will report how far the present complement of public draught cattle, is calculated to meet that object, and at the same time to answer the other demands usually made on the karkhana establishment.

2d. If unequal to both, the present complement of public cattle will be required to be increased, the extent of which increase you will also take into consideration, reporting the best means that may occur to you for the supply of the cattle.

3d. The breeding establishment would I hope, be fully adequate to keep the whole establishment complete *after* its formation, but the additional cattle that may now be required, ought I conceive to be purchased, and as cattle of the first quality only should be taken, I request you will report, whether such, to the necessary extent, could be procured in Mysore, and the probable cost of the same.

4th. It will also be for consideration, whether the whole or a part only of the drivers should be transferred to the Foot Artillery, and whether you conceive the men would be willing to be permanently transferred, on the favorable conditions held out to them in the paper furnished me by Colonel Freese; points on which you will be pleased to favor me with your opinion.

5th. It would not be expedient however, to make any of them the offer in case of any subsequent disappointment; as it will of course be a matter for future consideration, whether any should be so transferred, or whether it might not be more advisable to form a new establishment at once, for the purpose in view; or it might be deemed expedient to revise the footing of the present establishment, so as to assimilate the same with that which it has been proposed to attach to the Artillery. It will therefore be proper that you should consider this reference as confidential, and that the drivers for the present, should not be informed of its being in contemplation to transfer any portion of them from the present karkhana.

6th. These are the leading points which occur to me to be referred for your particular consideration, but I request you will give me your sentiments on the arrangement at large, suggesting whatever you may think best calculated for carrying the plan into effect, and to elucidate the amount of additional expense which it will occasion to government.

7th. I have by a circular letter to the officers in charge at the stations where cattle are proposed to be placed, called for estimates of the expense of providing them with gram, and, straw in the proportions laid down in the accompanying memorandum, (which shews the proposed distribution of the Artillery bullocks) and I request that you will favor me with an estimate of the difference of expense of the drivers with their petty officers according to the plan proposed.

(Signed) W. MORISON.
Commissary General.

MADRAS,
27th June, 1823.

To LIEUTENANT COLONEL MORISON, C. B.
Commissary General.

SIR,—I have the honor to acknowledge the receipt of your letter of the 27th June last, accompanied by a plan of general regulations for the formation of an establishment of draught bullocks and drivers, to be attached to the Foot Artillery; and requiring me to report, how far the present establishment of public draught cattle is calculated to meet the proposed object, and also to state my opinion with respect to other points connected with the arrangement in question.

2d. This plan requires with respect to the cattle, that the bullocks to be received for the Artillery, should be between the age of 5 and 8 years; not under the height of 50 inches, and be capable of drawing ordnance and carriages in the proportions detailed in the body of the proposed regulations, corresponding with the allotment of cattle for the draught of ordnance and carriages under the presidency of Fort William.

3d. These conditions particularly in regard to the number of cattle to be allotted to battering cannon, if adhered to, will, I conceive, make it at once impossible for the present establishment of public cattle, as well as the breeding establishment of cows, being rendered available for the formation of the proposed establishment, or for keeping it complete when formed. It is well known that the cattle attached to the Artillery on the Bengal establishment, are of a remarkably large size, and of a corresponding weight. It is also now admitted, that the powers of cattle of any description for the purposes of draught chiefly depend upon their weight and height, in the latter case, the additional power arising from the lever formed by the body and limbs of the animal exerting itself in the act of drawing, being proportionally lengthened; muscular activity and bottom are only so far necessary, as they enable the animal to exert the powers it derives from the possession of the former advantages for a longer or shorter period, or under circumstances of greater or lesser rapidity. While therefore the Bengal cattle from their superior size and weight, are enabled to move easily, ordnance, &c. with the prescribed allotment of bullocks, they probably have from the care and expense that is bestowed on breeding them, the requisite bottom to enable them to make their great powers applicable to all the exigencies of the Service. It would therefore appear to be indispensibly necessary in carrying into effect the plan as now proposed, in order if possible to ensure its efficiency under all circumstances of service, and to avert its failure at the time of need; that cattle should be procured corresponding in stature and weight to the Bengal Gun Bullocks, and that they should possess the bottom which these cattle no doubt have.

4. The bullocks of the present public cattle establishment, do not possess either extraordinary size or weight, though they have a fire, and muscular activity unequalled perhaps by any description of cattle throughout India; these qualities will enable them when allotted to ordnance in proportion to their size and weight, to perform perhaps more lengthened and arduous service, than most other descriptions of cattle; while their peculiar hardiness of constitution, enables them to bear up in a superior degree under all circumstances of change of soil and climate. That they can draw ordnance in the same proportions as the Bengal Gun Bullocks, is however, not to be expected, and I may here refer you to Captain Cubbon's report of the 20th February 1823, on the subject of their powers in the draft of heavy guns; on this account therefore I conceive that they cannot be considered as applicable to the formation or maintenance of the new establishment, agreeably to the proposed regulations with respect to the number of bullocks to be allotted to the different descriptions of ordnance, while further, on the subject of their height, I

beg to state, that I have had the whole of the cattle at the farm, including some of the largest Karkhanas on the establishment, carefully measured, and have found the average height of the whole, taken immediately behind the hump to amount to only 47¾ inches, while out of 1069 bullocks the number measured, only 114 reach to the height established as the lowest limit, at which cattle can be admitted on the strength of the new establishment, viz. 50 inches. The bullocks of this breed are also slower in arriving at maturity than most other cattle, they seldom attain their full growth until nearly seven years of age, while the limit with respect to age on the new establishment is proposed to be from 5 to 8 years.

5. In the event of its being ultimately determined, that the present breed of cattle should be set aside in the formation of the new establishment, the question occurs, from what source must the necessary supplies be procured?

6. In the Mysore territory, in the districts towards Chitteldroog and Mudgery, draft bullocks are to be procured of a breed approximating towards the one of which the public cattle department is composed; the prices from all I can learn, will vary from 80 to 150 rupees the pair, of the best sorts; the numbers that may be procurable, cannot I fear be ascertained with any accuracy, without dispatching people into the districts where the cattle are bred, a measure which would undoubtedly tend to raise the prices in the event of its becoming necessary to make purchases hereafter It cannot however I conceive be expected, that the size of these bullocks will exceed or perhaps even equal the height and size of those at present in the public cattle department, the latter are considered throughout Mysore as being the best cattle in the country, and are commonly known among the inhabitants by the Canarese phrase "doda dana" signifying "large cattle."

7. As far as my information will at present enable me to speak, the only part of the territories subject to the presidency of Fort St. George, where cattle of any size or quantity are produced, is comprised in the districts of Nellore, Ongole, and Guntoor, and in the southern parts of Masulipatam: the cattle of these countries although large and handsome, are however not remarkable for undergoing lengthened fatigue, particularly when combined with indifferent forage, and scanty means of grazing. I am also aware from my own observation when employed in the districts in question in the

year 1814, in procuring bulls and cows for the Bengal government, that it will be extremely difficult, if it be even possible, to procure at once a large number of bullocks of the proper age, owing to the inhabitants of the country always disposing of them at the age of 2 or 3 years, this they are enabled to do from the great demand that exists for cattle of this description, and they are induced to part with them thus early, both as it insures to them a quick return for the produce of their stock, and relieves them from the risk and expense of the custody of the cattle until they might reach a more mature age.

8. A number of draft cattle equal perhaps to the complement of the proposed establishment of the required standard, and possibly equal at first starting to drag ordnance in the proposed proportions, might perhaps be purchased in the different provinces under the Madras Government, by taking every large animal wherever it may be found, without reference to the country from whence it might originally have been brought. At a great expense a heterogeneous mass of cattle of all castes and dispositions would thus be collected, the qualities of which for enduring the fatigue of service in the field would be unknown, and which might therefore fail in the hour of necessity, from being unequal to the task imposed on them.

9. It would therefore appear to me, that if it be determined to procure cattle for the new establishment of equal working powers with those attached to the Bengal Artillery, that recourse must be had to countries beyond the frontiers of this presidency for the necessary supply. On this part of the subject however I am not at present prepared to enter, as the extent of my information will only permit me to name the countries where breeds of cattle of any note are produced, those conntries as far as I am at present aware, comprehend the provinces of Goozeraut and Scinde, the Rajpoot districts to tho north-west of Malwa, and the district of Hurrianah on the north-west frontier of the Bengal provinces.

10. If it may be permitted to me to offer a suggestion on the subject on which I have been desired to report, I would take the liberty respectfully to propose, that with the view of making the breed of cattle of which the public cattle establishment is now composed, available in the present formation of the new establishment, as well as for its maintenance hereafter, that the application of the services of the cattle about to be transferred, to the Foot Artillery, may

be confined to the draft of light field Artillery and carriages, for the proper manœuvring of which, (the chief advantage I apprehend that will be derived from the new arrangement) the Mysore cattle from their activity in movement are peculiarly adapted, that the standard at which the bullocks are to be passed may be lowered, and that the number of cattle allotted to each description of ordnance may remain as at present, until further experience at least may enable it to be proved, whether their powers may prove equal to the draft on the reduced rate. This plan as far as it regards the attaching the cattle that are exclusively under the Artillery officers to light field Artillery only, accords I believe with the system that prevails in Bengal; the Artillery bullocks and corps of drivers are there attached to field batteries, composed if I mistake not of light 12 and 6 pounders and 5½ inch howitzers; while a separate establishment exists under the name of the transport train, the management of which is separate and distinct from the Artillery bullocks; its services being applied in time of war, to the transport of battering ordnance and stores when required to be moved; while in time of peace, they are rendered useful to the Government in much the same manner as the services of the public cattle department under this presidency. The proportion of cattle under the present and in the proposed system, differs but little with respect to the light field Artillery and carriages. The number allotted to the draft of platform carts remains the same in both cases, for a light 12 pounder the difference is 2, for a 6 pounder is 2, and for a 5½ inch howitzer is 4 bullocks only, for each piece respectively.

11. The adoption of the modification allowed in the last paragraph, will at once render the extensive establishment of draft and breeding cattle at present at the disposal of the Government, available in the formation and for the future maintenance of the new establishment; which a strict adherence to the letter of the proposed regulation would not I think permit: such a modification will further prevent the loss to the service of a breed of cattle, the efficiency of the services of which in operations in the field has been felt and acknowledged, alike, when employed with our own troops, as when opposed to us in the armies of the former rulers of Mysore.

12. Should the new arrangement be confined to the movement of the light field Artillery, it may perhaps be

thought expedient that the present public cattle department under such modification, and on such a scale as may be determined on, should be made applicable to the movement of siege equipments on a large scale, when required to be attached to an Army in the field, as in the field transport train in Bengal; while in time of peace, the application of the services of the cattle to public purposes for which hired cattle would otherwise be required, in the manner that has hitherto obtained, will enable the establishment to be kept up at comparatively a trifling expense to Government; to enable the cattle of which the establishment is at present composed to execute the duties that would thus be required from it, it may be necessary that the allotment of bullocks for the draft of heavy ordnance should likewise not be altered at present; means however being adopted without delay to introduce gradually into the department, cattle of such size, weight, and bottom, as may enable the scale to be reduced at the earliest practicable moment.

13. The means that present themselves for introducing an establishment of large cattle, appear to me to be any of the three following plans; or perhaps what would be better, a combination of the three. *First*, the improvement with respect to size of the Mysore breed, a measure which I think may be accomplished by judicious interior arrangements in the breeding establishment; joined to the extension of that establishment to a scale that may enable only the calves of the very first description to be taken for the service; *secondly*, the importation of an adequate number of cattle of the required description, from those countries where the best breeds are produced: or *thirdly*, the adoption of means for the introduction of a breed of large bullocks in addition to the present breeding cattle, but to be kept separate and distinct from them. The success of the two last measures may perhaps be problematical, owing to the possibility of the climate, soil, and forage, of the Peninsula, not agreeing with the large cattle of the more northern countries: the subjecting of them to the test of experience will however afford the only means perhaps of forming a correct opinion on the subject.

14. Independent of the particular advantages that would arise from the employment of this establishment in the draft of battering guns in the field, it would become a nursery for the cattle required for the light field Artillery; for which branch any number might at once be drafted, ready trained and fit for service, should the exigency of the service at any time require an extension of that branch.

15. It may perhaps not be considered irrelevant to the present question, if I introduce into this report a short and general statement, regarding the manner in which the services of the department of public draft cattle as at present constituted, have been hitherto applied; as it may have the effect of elucidating the proposition made in the three preceding paragraphs, by exhibiting through the means of practical results, the advantage that accrues to Government from the maintenance of an establishment of cattle under similar circumstances.

16. The foundation of the present public cattle department as is well known, was the train of Artillery cattle belonging to the late Tippoo Sultan, which on the capture of Seringapatam were transferred to the public service; the source from whence its supplies of fresh bullocks were subsequently drawn being likewise the breeding establishment of the Sultan, which in a similar manner was reserved by the British Government, on the re establishment of the present dynasty in Mysore. The cattle belonging to this department since its formation, have been invariably employed when not required for service in the field, in duties chiefly connected with the ordnance department, for the execution of which other cattle must have been hired, had such a department not existed. By this means, for a long series of years and at a trifling expense, an extensive establishment of excellent draft cattle has been maintained at the disposal of the Government, ready at the notice of a moment to meet any of those sudden and unforeseen emergencies, which public events might have produced. The services of the establishment accordingly have often been called forth, and the cattle have from time to time been attached to different armies in the field. Of the manner in which they acquitted themselves when employed in the field, it fortunately does not now remain for me to speak; the accompanying statement however exhibits the balance against the establishment during the last 12 years, (being the period to the accounts of which I have access) setting off against the actual expenses of the department, the value of the work performed by the cattle actually employed during that time, or in other words, the amount that must have been paid for hired cattle for the performance of similar services both in the field and during peace. This balance therefore of Madras Rupees 223,465-13-9 equal to the present expenses of the establishment for only nine months, is the price that has been paid by Government for the

maintenance at all times of a public resource, of a nature so important and efficient as the establishment of Karkhana draft cattle presents, during the whole period to which the statement refers; without taking into the calculation the great public advantages that resulted from the efficient performance of the services of the cattle when employed in the field

17. It will of course occur to you that the original cost of the cattle does not enter into the foregoing calculation; this cost comprises the price paid to the Mysore Government for the calves received from the breeding establishment previous to its transfer to this department, as well as the expenses of that establishment since the transfer; against this cost however, which will bear but a small proportion to the expenses of the maintenance of the cattle, a considerable off set exists in the value of the extensive stock of the breeding establishment, as also of the present draft cattle themselves, together with the prices of the cattle which from time to time have been condemned and sold.

18. I will take the liberty to submit another statement, from which it will appear that the average expense of one draft bullock during the last 12 official years, as deduced from the accounts of that period, during which great numbers of the cattle were maintained at a great expense in the field, amounts to only Rupees 3-3-2. If to this be added the proportional part of the attendants pay both in garrison and in the field that will fall to one bullock, the total cost of each bullock on the establishment per month will be Rupees 5-15-3 and 7-0-1, respectively.

19. I now proceed to reply to the part of your letter already acknowledged, which requires me to report, on how far the present complement of public draft cattle is calculated to meet the formation of the new establishment, and at the same time to answer the other demands usually made on the Karkhana department. The final consideration of this part of the subject will of course require, that the question should be determined, of how far the present establishment can be made applicable for the new department. In reporting in this place on the subject, I will however consider the present department as available for the formation of the new one.

20. The usual demands made on the Karkhana department during peace, may be comprised under the heads of the cattle employed in dragging timber and charcoal for the use of the Gun Carriage Manufactory at Seringapatam; those employed in the conveyance of the carriages constructed at the manufactory, from Seringapatam to the different stations to which they are allotted; those employed in the conveyance of military stores from the Arsenal at Seringapatam to other stations; and the occasional employment of the cattle in the draft of arrack and sick carts with corps marching from station to station. I exclude altogether from this enumeration, the cattle at present stationed with the different divisions of the army; as I conclude that under the proposed system their services will not be required in those situations in the manner that has hitherto obtained.

21. Of the different services on which the cattle are usually employed as just stated, those that are attached to the timber and charcoal service of the gun carriage manufactory, may be considered as required to be permanently performed; while the number that has been detached from the farm for the transportation of arrack and sick carts is so small, that it may perhaps be safely omitted from the present calculation. I beg to submit a detailed statement, shewing the number of bullocks that have been employed on the timber and charcoal services during the last 12 years, from which it will appear that there are at present 1075 employed on that duty. To preserve these cattle in a state of efficiency for field service, it will be absolutely necessary that they should be relieved at least every six months, as the work on which they are employed in all seasons, is laborious and incessant; and to effect this relief, at least 500 additional bullocks will be required to be maintained.

22. A statement of the number of public draft bullocks employed in transporting carriages and military stores, from Seringapatam to other stations during the last 12 years also accompanies this report; excluding from it the year 1818, during which period very few public cattle were furnished for the services in question, also the present year which is incomplete, the average number of cattle employed in each year will be 1957, assuming therefore this number as that which will be necessary to perform services of this nature, an additional number of about 1900 bullocks will be required to be maintained to meet the present demand. It will occur to you, that the cattle stated as being employed in each year were

not actually employed during the whole year, but that they were detached at different periods ; as the cattle however cannot return from the station to which the greater number are detached under three and four months, it may be considered that in order to allow the necessary rest to the cattle employed, the average number just stated are required to meet this service during each year.

23. From what has just been detailed, the number of cattle required for the formation of the new establishment, and to answer the other demands made on the Karkhana department will be as under.

Proposed establishment for the Foot Artillery....	2720
Required for the gun carriage timber, and charcoal services including relief.......................	1576
Required to meet the occasional demands for cattle required to transport carriages and military stores, from Seringapatam to other stations....	1900
	6196
Deduct present establishment of Karkhana department....................................	4200
Deficient....................................	1996

From which it would appear that the present establishment, will be required to be increased by about 2000 head of cattle, in order to enable it to meet the whole of the demands now under consideration.

24. It may perhaps be necessary for me to add, that in addition to the public cattle furnished for the transportation of ordnance carriages and military stores from Seringapatam, a considerable number of hired cattle have at different times been supplied for those services by this department ; a statement of the number furnished in each year since the establishment of the commissariat is also forwarded with this report.

25. It will of course be necessary that the additional cattle should in the first instance be purchased ; and as I have already stated, the Mysore territory will afford the means of procuring a proportion of the number, provided they

be taken of a size and breed, assimilating to that, of which the present establishment is composed : while should it be determined to introduce large cattle into the department in addition to the present breed, the number which Mysore may not afford, might be perhaps procured from those countries beyond the frontiers where breeds of cattle of any character are to be found, and to which allusion has already been made in this report.

26. With respect to the subject of the drivers, I beg to state, that though perhaps many may be found willing to be permanently attached to the Artillery under the favorable conditions held out to them in the proposed plan, yet I am doubtful whether the measure would be generally satisfactory among them. The greater part of the drivers are natives of the western part of Mysore where all their connexions reside ; under the present system the periods of the return of the attendants to Mysore have been frequent and certain, whenever the service on which they might have been employed was at an end : by this means a constant intercourse has been kept up between them and their relations, a circumstance which I conceive has in a great measure contributed to maintain them in a state of good order, and to keep them well disposed to the service under all the disadvantages attending their situation. This occasional and constantly recurring intercourse with Mysore, it is obvious cannot be ensured to the attendants under the new system, even allowing them the utmost possible indulgence with respect to furlough ; and on this account chiefly I am of opinion that there will exist a feeling adverse to their entering willingly into the new establishment.

27. I cannot avoid taking this opportunity of earnestly recommending to your attention, the expediency of the entire revision of the present establishment of attendants, with the view to assimilate it with that which it has been proposed to attach to the Artillery ; should that measure be carried into effect, the present attendants on the draft cattle are worse paid than any other description of public followers attached to the Army, they are only allowed batta when serving against an enemy in the field, or when employed to the north of the Kistnah ; they are not eligible for the Pension establishment, nor is any provision held out to them if maimed on service ; though on many occasions they must of necessity be exposed to the fire of the enemy equally with the troops ; they are not allowed clothing, and have only the

benefit of medical aid when employed on actual service, on the other hand the duties which they have to execute are incessant and laborious. At this depôt, it becomes the duty of every attendant attached to it, to proceed on command several times in every year, and even when present at the farm those not actually required for the care of the bullocks, are employed from morning until night in the numerous extra duties which are constantly occurring at the depôt; a more hard working body of men, and one whose services of whatever nature they may be are more willingly rendered, I will be bound to say the government do not possess. On any occasion of service also, the present establishment alike with the one proposed to be attached to the Artillery, must of course be employed either with that corps, or on duties connected with it. The inconvenience that in this case would result, from two classes of men executing the same or similar duties under different advantages is so obvious, that it may be merely necessary for me here to allude to it.

28. I have the honor agreeably to your request, to transmit a statement showing the monthly and annual expense of the attendants required for 2720 bullocks on the present and proposed systems, both in garrison and in the field; from which it appears that the expense of the proposed system exceeds the present, in the yearly sum of Madras rupees 37,509-0-0 in garrison, and Madras rupees 45,153-0-0 in the field.

29. The statements that will be forwarded to you by the officers in charge at the stations where the cattle are proposed to be placed, will afford you tolerably correct means of ascertaining the expense of the new establishment on account of the subsistence of the bullocks when in garrison. In the event of any part of the cattle being employed on field service, the expense of course will be greatly increased, though from the ever varying circumstances attending such a situation, it will not be possible to frame a correct estimate of it; I beg however again to refer you to the statement No. 2 for information regarding the actual average expenses of the cattle on the present system, under joint circumstances of war and peace.

30. I must however here remark, that it is only when the cattle on the present establishment are actually employed, that the expense incurred in subsisting them is of any moment. When unemployed at the different grazing depôts no forage is ever purchased for them, excepting for a change of

food to such as are sick, and each bullock receives only one seer of gram daily. At the depôt at the grazing farm, the average expense of one bullock unemployed, deduced from the accounts for the last 12 years has amounted to only rupees 1—1—3 per month.

31. The amount of dry forage which in the new plan it is proposed to give to the cattle, viz. 7lbs to each bullock daily, amounts to about one half of the quantity received by the cattle under the present system when employed, in addition to two seers of gram, the allowance that is then made to them. This allowance of 7 lbs. of forage will, I fear, hardly prove adequate to maintain the cattle in condition under the almost total privation with respect to grazing, which they must experience when permanently fixed at such stations as Secunderabad, and Saint Thomas's Mount. Under favorable circumstances of grazing, (the natural means of subsistence of horned cattle) very little extra food of any sort is requisite to keep them in condition, but in the contrary case, even the additional quantity of gram which it is proposed to give to them with the above specified quantity of forage, will not I am apprehensive answer the purpose; and I may here state that I have instituted experiments at the farm on the subject, by feeding certain bullocks on three and two seers of gram each per diem, with 7 lbs. of forage added in both cases, taking measures at the same time to prevent their being allowed to graze, and working them moderately each day. The cattle have been under this treatment for a month, and although they were in excellent condition when the experiments commenced, they are now little else than skin and bone. It must however be added that they continue in good health, and that probably the sudden transition from the abundant grazing that they had at the farm, to absolute privation in that respect, may have conduced to the very reduced state in which they now appear.

32. I will here further add with reference to the proposed measure of foraging, and for carrying the picketing ropes, &c. on the march, by means of the spare cattle, that under the present system an establishment of forage bullocks have been maintained since the time of Tippoo Sultan, in the proportion of twelve to each Karkhana of 100 draft bullocks, by means of which the services just mentioned are always performed; these forage bullocks are kept up without expense, no allowance of gram or forage being allowed to them in any

situation, they receiving a small share of what is issued for the use of the Karkhanas to which they are attached. The picketing, driving and leading ropes, which are now proposed to be issued from the ordnance stores, have always heretofore been prepared by the attendants themselves without any expense to the public.

(Signed) M. H. DAVIDSON,

Dep. Asst. Commissary Genl.

GRAZING FARM NEAR
SERINGAPATAM,
12*th August*, 1823.

NOTE.—The statements referred to in this letter are not inserted, but the deductions founded on them, will in general be apparent.

MILITARY DEPARTMENT.

Extract from the Minutes of the Honorable the Governor in Council, dated 10*th September* 1824.

" The Governor in Council is fully convinced of the great advantages which will attend the plan of attaching draught bullocks permanently to the Foot Artillery brought forward by Lieutenant Colonel Noble, and is desirous of carrying it into effect to such extent as the resources of this part of India in cattle will at present allow. Cattle of a superior description are indispensable to the success of the plan, and it is well known that the common cattle of the country are of the worst kind. The main reliance must therefore be placed upon the breeding establishment in Mysore, and, independently of the time which must elapse before that establishment could be augmented to the requisite scale, it remains to be considered, whether the Mysore Government would be bound to make a corresponding increase of the advantages, which the establishment has hitherto enjoyed. On a view of all the circumstances of the case therefore, the Governor in Council is of opinion, that it will be necessary for the present, to restrict the plan to eight Karkhanas; these will include the companies of Artillery attached to the Hyderabad and Nagpore Subsidiary Forces, which are those that it is of most importance to keep in a state of complete efficiency."

" With the view of carrying the proposed arrangement into effect, the Commissary General will be authorized to increase the present establishment of draught bullocks from 4200 to 5000. The Commissariat officer in charge of the Mysore farm, will be employed to organize the eight new Karkhanas of bullocks for the Artillery. Each Karkhana will consist of 160 bullocks. The bullocks would be aged and sized according to the plan followed in forming the present karkhanas, having each a proportion of all ages from six upwards, the eldest being still fit for two years service; no standard size should be fixed till experience is obtained both as to the wants of the Artillery, and the public resources in cattle."

" The contract for 814 bullocks at Hyderabad is to be discontinued, and the requisite number supplied in future by the Commissariat. The Commissary General will be authorized to purchase any bullocks either of the Hyderabad contractor or elsewhere, that may be fit for the service."

" The bullocks for the Artillery at St. Thomas's Mount, should not be brought down, until a stock of one year's forage has been provided for them."

" Each Karkhana is to have 1 darogha, 4 choudries, and 80 drivers attached to it. The drivers are to be raised and organized by the officers of Artillery, and the Commander-in-Chief will be pleased to issue the necessary instructions for that purpose. Any of the present drivers who may volunteer to serve in the new corps of drivers, and are fit for service, may be entertained."

" After the Karkhanas of bullocks have been made over to the officers of Artillery, each officer in charge of Artillery cattle, is to furnish the Commissary General with a monthly return of such cattle, to report to him the particulars of all casualties, and transmit to him copies of the proceedings of casting committees."

" The Commander-in-Chief will be requested to state, to what extent His Excellency would recommend that the number of gun Lascars should be reduced, in consequence of the bullocks attached to the Artillery. His Excellency will also be requested to give such orders as may be necessary for carrying the foregoing resolutions into effect."

"Ordered, that the foregoing resolutions be communicated for the information and guidance of the Military Board, the Commissary General, and the Military Auditor General respectively."

(A true Extract)

(Signed) D. HILL,

Chief Secretary.

Extract from Artillery Orders No. 73, dated Saint Thomas's Mount, 14th July 1825.

The following letter from the Adjutant General of the Army, is published for the information and guidance of the officers of the corps.

No. 133.

To LIEUTENANT-COLONEL LIMOND,

Acting Commandant of Artillery.

Sir,—You have already been furnished by the Commander-in-Chief's Military Secretary, with an extract from the minutes of council as per margin, and I am directed by Lieutenant General Bowser, Commanding the Army in Chief, to request that you will proceed to recruit and organize two establishments of drivers, for the Karkhana cattle to be attached to the Artillery with the Nagpoor Subsidiary Force, and two for the Artillery attached to the Hyderabad Subsidiary Force, according to the resolution contained in the foregoing minute. The drivers for *each* Karkhana are to be of the strength detailed in the margin.

10th September 1824.

1 Darogah.
6 Chowdries.
80 Drivers.
for 1 Karkannah of 160 Bullocks.

2. In recruiting for this establishment, you will give the preference to any of the present drivers who may volunteer to serve in the new corps of drivers, and who may be found fit for the service.

3. After the Karkhanas of bullocks have been received in charge by the officers of Artillery, you will direct the monthly returns of such cattle to be made to the Commis-

sary General, to report to him the particulars of all casualties, and transmit to him copies of the proceedings of casting committees, and a return of cattle and drivers with lists of alterations and casualties are also to be added to the monthly returns of the corps or detachments with which they are serving, made to this office.

4. You will be pleased to forward to this office, the details of the arrangements you make with reference to these orders, and also report the date from which it has effect.

5. These Karkhanas and drivers are to be attached to the light field ordnance of the Nagpoor and the Hyderabad Subsidiary Forces respectively, viz. two Karkhanas to each Force.

6. The pay and batta of the corps of Artillery drivers is fixed as follows,

Rank.	Pay Rs. per month.	Batta per day. A.	P.	C.
1 Darogah	17	2	5	87
1 Choudry	12	1	10	40
1 Driver	7	1	2	93

7. An allowance for stationery of 3 rupees and 8 annas is allowed to each company, and a man in each company also is allowed to be employed under the designation of "bullock serjeant," with a staff allowance of 10 rupees per month, for the purpose of superintending the gram department and keeping the accounts of the cattle establishment.

8. The drivers admitted into the service are not to be under the height of 5 feet 4 inches, and the age of admission to be between 18 and 22 years.

9. The drivers to be eligible to the Pension list under the same rules and regulations as the Native army in general.

10. The drivers will be clothed by Government, each man to receive annually, one loose blue coarse woollen jacket turned up with red, like the horse brigade camel drivers. The darogahs and chowdries jackets to be made of cloth of a finer quality.

11. The drivers to furnish under regimental regulations, an uniform turband, cummerbund and trowsers, as also driving whips.

12. The drivers to be allowed medical attendance the same as other Native followers.

13. The corps of drivers to be subject to the rules of military discipline and articles of war, and not to be discharged but under authority from head quarters. They are to be paid, mustered, and returned, as other troops, and their registers and accounts kept in like manner.

14. The cattle required for the service of the Artillery, will be provided by the Commissariat under the same system as obtains for the supply of remount horses, and according to the description given in the minutes of council 10th September 1824.

15. All cattle supplied for the service of the Artillery, are to be examined and passed by a Committee of Artillery officers, who will certify their opinion that the cattle are strong enough for the draft of ordnance and carriages in the field.

16. Each bullock to be allowed a full sized cumly or jhool, a feeding gunny 3 feet square, also leathers for soaking gram in the proportion of 5 to each company, and a curry comb and hand rubber to each pair of cattle. These articles to be supplied when required, by the commissariat on indents signed by the officer commanding the company, and approved and countersigned by the officer commanding the Artillery on the spot.

17. Each bullock in the field, or when marching with guns, is to be allowed 3 seers of gram and 7 pounds of dry forage daily, but in Cantonments 2 seers of gram and 7 pounds of dry forage is fixed as the daily feed of each bullock. These supplies to be furnished by the Commissariat. Boosah or curbie is the description of forage to be issued when procurable, but when otherwise, the description of dry forage is to be regulated by the supplies of the country, and when dry forage is not procurable of any description, double the weight of green forage is to be issued.

18. The drivers and cattle are to be employed in foraging in addition to what the Commissariat furnishes, and for this purpose a proportion of spare cattle are to be supplied with saddles to be supplied by the Commissariat.

19. Picketing ropes, driving and leading ropes, &c. &c. will be supplied on indent from the Ordnance stores, in like

manner as other articles of ordnance stores. The ropes, jhools, &c. are to be carried on the march by the spare bullocks.

20. Mussalls when occasionally required for the cattle, and medicine for sick cattle, with a proportion of coarse salt (one measure monthly) for each bullock, to be supplied by the Commissariat; when there is no Commissariat officer or servant of that department to furnish the supplies mentioned in these regulations, the officer commanding the company under the sanction of the commanding officer of the Artillery on the spot, and the commanding officer of the camp, is to furnish the supplies, sending his bill on honour to the Commissariat officer for payment.

(Signed) T. H. S. CONWAY,
Adjutant General of the Army.

HEAD QUARTERS OF THE ARMY,
ADJUTANT GENERAL'S OFFICE,
BANGALORE, *4th July*, 1825.

In carrying into effect the above detailed instructions, for the equipment of the Foot Artillery guns with Karkhana bullocks and drivers on a permanent footing, the following is directed.

The commanding officers of the Artillery with the Hyderabad and Nagpore forces, are requested to give the necessary orders to the officers in charge of Foot Artillery, to recruit the drivers with as little delay as possible. The attention of these officers is particularly directed to the 8th para. of the Adjutant General's letter, and as these people are to have all the advantages of a permanent provision, it is hoped that men of most unexceptionable description will be procurable. Should any difficulty however occur in obtaining the speedy entertainment of the complement on the spot, the respective commanding officers will report the same to the Assistant Adjutant General of Artillery, that measures may be taken for assisting the recruiting from other sources.

As this is a permanent establishment on the same footing as the Native soldier, particular attention is required to the description and register rolls of these men, and as soon as the full complement of the Karkhanas with these forces shall be completed, the commanding officers will forward to the Assistant Adjutant General, recommendation rolls of the men they shall have selected for the ranks of darogah and chowdries, that they may have the public confirmation of the Commandant of Artillery. These ranks after having had this public nomination, can only be removed by that authority or the sentence of a Court Martial approved by the commanding officer of the force, with which the detachment may be serving at the time.

Progress reports of the establishment are directed to be forwarded weekly to the Assistant Adjutant General, for the information of the Commandant of Artillery.

The following uniform is established to be worn with the dress furnished by government.

The turband to be bright red. The darogah having the addition of a double band of red cloth of one inch wide round the right arm above the elbow, and the chowdries one.

The trowsers to be dark brown curwah with blue cummerbund.

As the ordnance allotted to the Foot Artillery companies under the new system, will be permanently attached on the same principle as the ordnance of the Horse brigade, commanding officers are requested to order the necessary indents to be prepared and forwarded for the approval of the Commandant of Artillery, which will be returned after having received the sanction of the Military Board.

The form of drill and exercise as directed in the Artillery order of the 30th May 1825, is ordered to be adopted. The acting commandant of Artillery will at the same time be happy to receive from officers any suggestion that may appear to them to improve the system.

In consequence of the adoption of the new system, further entertainment of gun lascars will cease.

G. O. C. C. 28th December 1825.

The Honorable the Governor in Council having addressed the subjoined order to Lieutenant General Bowser, commanding the Army in chief, to be published to the Army, it is accordingly published in military orders.

FORT ST. GEORGE, *23d Sept.* 1825.

G. O. by Government.

Para. 1. The Honorable the Governor in Council having resolved that eight companies or Karkhanas of drivers and draught bullocks, consisting of one darogah, four chowdries, eighty drivers, and one hundred and sixty draught bullocks each, shall be raised for the service of the European Foot Artillery under this Presidency, has been pleased to publish the following regulations for general information.

2. The drivers to be raised and organized under instructions which the Commandant of Artillery will receive from Head Quarters; their height not being under 5 feet 4 inches, nor their age below 18 nor above 28 years. When the establishment has been completed, recruits should not be entertained who are above 22 years of age.

3. The drivers and cattle to be under the general controul of the senior officer of Artillery wherever they may be stationed; but in special charge of the officers commanding the companies of Foot Artillery, to which they may be attached.

4. The pay and batta of the Artillery drivers are fixed as follows.

	Monthly Pay.		Daily Batta.		
	Rupees.		As.	P.	C.
1 Darogah.......	17	0	2	5	87
1 Chowdry	12	0	1	10	40
1 Driver.........	6	8	1	2	93

Batta to be allowed in the field, at field stations, or when marching. An allowance of rupees 3½ per mensem is allowed to each company for stationery, also an allowance of rupees 10-0-0 per mensem, for a non-commissioned officer for the purpose of assisting in superintending the cattle, and the receipts and issue of gram and forage.

5. The drivers to be paid and mustered, and their registers, records, and accounts to be kept according to the forms and system of the Native troops; the officer to whose company they may be attached being charged with the duty of

drawing their pay on abstract, together with the further allowances specified in the 4th paragraph of this regulation.

6. The drivers to be subject to the rules of military discipline, and the articles of war ; and are not to be discharged from the service but under authority from head quarters.

7. The drivers to be allowed medical aid, and to benefit by the regulations for the issue of gram or compensation money and family certificates the same as the regular troops. Those who may be disabled in the execution of their duty or wounded in action, to be eligible to the pension list ; and the families of drivers killed in action, will be entitled to pensions, the same as the heirs of sepoys.

8. The companies or Karkhanas of cattle, consisting in the first instance of bullocks of all serviceable ages from six upwards, to be formed and delivered to the Artillery by the Commissariat, and to be annually recruited by bullocks, not younger than six years of age, from the breeding establishment in Mysore ; on the requisition of head quarters, through the Quarter Master General of the Army.

9. The recruit cattle supplied from that establishment for the service of the artillery companies, shall be inspected at Seringapatam by committees of officers, the survey reports to contain a general description of the cast, figure, bone, strength and fitness of the animal ; and each bullock when passed shall be branded in the presence of the committee, on the off haunch with the two final figures of the year, and the letter A. (Artillery) If there be any Artillery officers at Seringapatam, their services will be required on such committees.

10. No Standard height is yet fixed for the bullocks, and the present allotment to all descriptions of ordnance and ordnance carriages, shall continue in force untill further orders.

11. When bullocks become unfit for service, either from age, accident, or incurable distemper ; they will be cast on regular survey, the proceedings being forwarded to head quarters through the Quarter Master General of the Army ; copies being transmitted at the same time to theCommissary General, and to the Commissariat officer on the spot.

12. In the field or at field stations in cases of emergency, the cast cattle will be replaced temporarily by the

Commissariat officer on the spot, under the orders of the officer commanding the force; such cattle being eventually relieved by fresh bullocks from the breeding establishment, in the manner prescribed in the 10th paragraph.

13. All cast bullocks to be branded with the letter R. (rejected) in presence of the officers of survey; then delivered over to the Commissariat and struck off the returns of the company or Karkhana. Such cattle will be disposed of under the orders of the Commissary General.

14. The monthly returns of the Artillery companies to which draught cattle are attached, when sent to head quarters are required to include in additional columns, both the drivers, and the bullocks; separate returns of the latter only being sent to the Commissary General with the particulars of all casualties, and a copy of the same to the Commissariat officer on the spot.

15. The bullocks shall be invariably turned out to graze, whenever grazing ground is procurable, and circumstances will permit.

16. Each draught bullock is allowed 2 seers of gram, and 14lbs. of dry forage daily in cantonment, and 3 seers of gram and 14lbs. of dry forage in the field, or marching with guns or carriages; and half a seer of common salt per month. When dry forage is not procurable, double the weight of green is to be issued to the cattle. It will rest with the Artillery officer in charge, to diminish the allowance of gram, whenever the health of the cattle or the abundance of forage may render such reduction advisable.

17. The dry forage for the use of the cattle in the cantonments, will be provided at the most favorable season by the Commissariat, and at once delivered to the charge of the Artillery, 10 per cent. being added to cover wastage. Gram will also be delivered in quantity, where the Artillery have accommodation for the same, as in the department of Cavalry supplies, the same wastage being allowed, viz. $\frac{1}{4}$ per cent. monthly. In both these cases returns of receipts and issues are required to be made to the Military Board. In the field or when marching, gram and dry forage will be furnished by the Commissariat daily, drivers being allotted for bringing in the forage; and when green forage only is procurable whether wild or cultivated, the driver will necessarily cut and bring it in.

18. Each bullock to be allowed one full sized cumly-jhool annually; and each company or Karkhana feeding-gunnies 100 feet long (in convenient pieces) and 18 inches broad; five soaking skins, and 35 fathoms of picketing ground rope (coir when procurable) every four months. Pickets, head-ropes, hand rubbers, grass knives and whips (one of each to each driver), and 10 gram baskets, to be furnished in the first instance by the Commissariat, and afterwards kept complete by the drivers.

19. The whole of these articles to be in charge of the establishment of drivers. The cumbly-jhools, feeding gunnies, gram baskets, pickets, picketing ropes and hand rubbers to be carried when marching by the Commissariat which department will be allowed to entertain carriage bullocks for the purpose; for the carriage of gram, and for foraging, not exceeding 12 for every 100 draught cattle.

20. Massauls and medicines for sick cattle, and shoes for tender-footed bullocks to be provided by the Artillery officer in charge of the cattle, to be charged for, in monthly bills; which will be paid by the Paymaster, when countersigned by the Senior officer of the Artillery on the spot, and the officer commanding the force.

21. The success of this plan, especially on actual service, will in a great degree depend on a proper, mutual cooperation between the officers of the Artillery and of the Commissariat, in maintaining the cattle in the most efficient order and condition; and the Honorable the Governor in Council expects from them both, every exertion calculated to promote this important object.

22. It will of course rest with the commandant of Artillery, to obtain such returns as he may require, from the Artillery officers in charge of drivers and cattle, and to give such orders, under the sanction of the Commander in Chief, as may be deemed proper, regarding the interior management of the same, whether with respect to the promotion of drivers to the higher ranks, or for the care and complete efficiency of the whole.

23. The officer commanding the army in chief will be pleased to give such subsidiary orders as may be necessary to give effect to these regulations.

By order of the Honorable the Governor in Council.

(Signed) D. HILL,
Chief Secretary.

Extract from Artillery Orders dated Saint Thomas's Mount, 14*th February* 1826.

A. O. No. 115.

The Commandant of Artillery with a view to establish an uniformity in the returns of drivers and cattle permanently attached to the Foot Artillery, those hitherto sent to the Commissary General having included drivers as well as bullocks which is not required, and differing from each other in many respects, is pleased to give publication to the following form of a monthly return to that department. and directs in future that these documents be prepared accordingly.

Return for January 1826 *of the Honorable Company's draught bullocks attached to ——— No. —— Karkhana of the ————— battalion of Artillery at ————*

	Draught Bullocks.
Present for duty	
Sick present	
Absent On Command	
Absent On Leave	
Absent Sick	
Establishment.	
Wanting to complete.	

On Command.

Draught Bullocks.	By whom ordered and when.	Where sent and on what service.
		Total.

Alterations and Casualties since last Return.

	Dead.	Received from the Commissariat.	Transferred to the Commissariat.	Date.	Particulars of Casualties.	Included.	Not included.
Draught Bullocks							

The Commandant also directs, that corps and detachments to which bullocks are attached, shall in their monthly returns to the Assistant Adjutant General of Artillery, include the Karkhana Establishment, by adding columns for the several ranks of the Drivers, and for the cattle, in the body of the return; and that correct lists of all alterations and casualties in the establishment, be inserted under their proper heads, in all returns of battalions or companies to which Karkhanas are attached.

G. O. C. C. 1st March 1826.

Under the sanction of Government, the Officer Commanding the Army in Chief, is pleased to fix the uniform of the Corps of Artillery drivers, (as instituted by G. O. G. 23d September 1825) to be dark blue faced with red. The jackets of the Drivers to be formed like those of the Store lascars, and the jackets of the Darogah and Choudries, like those of the Horse brigade Camel drivers. The drivers to furnish under Regimental arrangement, an uniform turband and cummerbund of red cotton cloth, two ungrekas, and two pair of trowsers.

When clothing is not issued, compensation in licu of it will be allowed as follows, viz.

Darogah...........................	Rs.	4	6	11⅕
Choudry...........................		2	8	4
Driver.............................		2	1	7⅕

Extract from Artillery Orders, No. 154, *dated St. Thomas's Mount, 20th December,* 1826.

With a view to prevent too many Non-Commissioned being on the Staff, the Commandant of Artillery is pleased to direct, that the situation of Bullock Serjeant, be held by a Bombardier or Gunner, and on promotion vacated, steady old soldiers are to be selected for these situations, and recommendations for their appointment submitted to the Commandant for confirmation.

G. O. G. 18th September, 1827.

The Right Honorable the Governor in Council is pleased to direct, that the following articles shall be supplied every fourth month by the Commissariat department, to each artillery Karkhana of bullocks, in addition to those enumerated in General Orders of the 23d September 1825.

	Articles.	Quality.
428	yards of Leading rope	Of Date rope, or Cocoanut rope.
246	— of Nose rope	
480	— of Neck rope	
440	— of Head rope	
8	large baskets	Of Date, Bamboo, or Rattan.
6	small „	

Extract from Artillery Orders, No. 190, *dated St. Thomas's Mount,* 12*th October* 1827.

The following extract from an extract from the minutes of the Honorable the Governor in Council, dated 18th September 1827, is published for general information.

The Governor in Council also sanctions the construction of a Gram-godown and shed for each Karkhana of bullocks with the Artillery, and authorizes the Military Board to pass indents for branding irons for their use, as recommended by the Commander-in-Chief.

A true extract,

(Signed) R. Clive.

Extract from Artillery Orders, No. 197, *dated St. Thomas's Mount,* 17*th December* 1827.

The following letter from the office of the Adjutant General of the Army, is published for the information and guidance of the Officers of the Corps of Artillery.

No. 7807.

To COLONEL Sir JOHN SINCLAIR, Bart.

Commandant of Artillery.

Sir,—I am directed to acknowledge the receipt of your letter of the 9th instant, and in reply, the Commander-in-Chief has desired me to acquaint you, that the height of the Drivers with the Karkhana establishment, is not considered of so much consequence as his eligibility in other respects, and His Excellency with reference to the 22d para. of the General Order by Government of the 23d September 1825, is pleased to sanction such deviations from the rules laid down for the enlistment of Drivers, in regard to their height and age, as may promise to ensure success to the plan adopted, of attaching draught bullocks to battalions, for the service of the Foot Artillery.

Too much care cannot be bestowed upon so important an object to the Foot Artillery branch of the service, as the judicious selection and enlistment of men as Drivers, and none should be entertained, but such as are fit in point of health, strength, character, and knowledge of cattle ; and to these injunctions, the Commander-in-Chief desires you will call the particular and unceasing attention of Officers Commanding battalions and detachments of Foot Artillery, as most essential points in maintaining the Cattle in efficient order and good condition.

FORT ST. GEORGE, 12*th December* 1827. (Signed) B. R. HITCHENS, *Depy. Adjt. General.*

Extract from Artillery Orders, No. 283, *dated St. Thomas's Mount*, 10*th September* 1829.

A new pattern Whip having been established for the several Karkhanas of the regiment, and ready for delivery at the Arsenal of Fort St. George, Officers Commanding Karkhanas, will be pleased to forward Indents to the Director Artillery Depôt, for the full complement of Whips ; each driver is in the first instance, furnished with a whip gratis, afterwards to supply themselves, and Officers Commanding are called on to see that no deviation whatever is made from the established pattern.

Extract from Artillery Orders, dated St. Thomas's Mount, 24*th May* 1831.

With reference to enlisting Drivers for the Karkhana establishment, the Acting Commandant of Artillery requests, that officers in charge of Karkhanas will give preference to Gun lascars and Recruit boys, who may, by late reductions, be removed from the Service, and who may be eligible, with consideration to claim and character.

Extract from Artillery Orders, No. 294, *dated St. Thomas's Mount*, 4*th January* 1830.

The new pattern pole bar for Horse Artillery, and bullock yoke for Foot Artillery, being ready for delivery at the Arsenal of Fort St. George, Officers commanding brigades, battalions and detachments, will be pleased to send in Indents without delay, for the number required to replace those in present use, on the Principal Commissary of Ordnance through the Director Artillery Depôt.

The pole bar to be gradually introduced as the present ones become unserviceable. The bullock yokes to be used at once and the old ones thrown into Store, being required for the train.

On the introduction of the new bullock yoke, the pole driver only is to ride. the other drivers to walk, each between the pair of bullocks under their charge respectively.

G. O. by Government, No. 263, *Fort St. George,* 17*th December* 1830.

The Right Honorable the Governor in Council, having had under consideration the allotment of cattle for country and platform carts, in the removal of Military stores as laid down in form No. 2, section 11th, Ordnance regulations, is pleased to direct, that loads of Military stores in transit from station to station, within, as well as beyond the frontiers of the Company's country, shall in future be regulated by the following scale, the load being calculated in addition to the weight of the cart, viz.

For a country cart with 2 bullocks......		lbs.	800
For a new pattern store do.	do.........	„	800
For a platform cart	do.........	„	700
For a platform cart with 4	do.........	„	1200

The allotment above alluded to, remaining unaltered for field service.

By order of the Right Hon'ble the Governor in Council.

(Signed) Robert Clerk,
Secy. to Government.

G. O. by Government No. 72, *Fort St. George* 12*th Jan.* 1831.

The Right Honorable the Governor in Council is pleased to direct, the publication of the following revised Table, exhibiting the numbers of draft cattle for the several descriptions of Ordnance carriages, mounted and dismounted for field service, and for removal from one station to another,

	In the Field.			From Station to Station.		
	In Yoke.	Spare.	Total.	In Yoke.	Spare.	Total.
Iron gun carriage and limber. . 24 pdr.	44	9	53	26	5	31
„ „ „ „ dismounted „	20	4	24	12	2	14
„ „ „ „ 18 pdr	38	8	46	24	4	28
„ „ „ „ dismounted „	18	4	22	10	2	12
„ „ „ „ 12 pdr.	30	6	36	18	3	21
„ „ „ „ dismounted „	14	3	17	8	2	10
„ Howitzer „ „ 10 inch . . . . „ dismounted „	Carriage not fixed.					
„ „ „ „ 8 inch.	26	5	31	16	3	19
„ „ „ „ dismounted „	16	3	19	10	2	12
Brass gun carriage and limber. . 12 pdr.	12	2	14	0	0	0
„ „ „ „ dismounted „	6	1	7	0	0	0
„ „ „ „ 9 pounder	10	2	12	0	0	0
„ „ „ „ dismounted „	6	1	7	0	0	0
„ „ „ „ 6 pounder	8	1	9	0	0	0
„ „ „ „ dismounted „	6	1	7	0	0	0
„ „ „ „ 3 pounder	6	1	7	0	0	0
„ „ „ „ dismounted „	4	1	5	0	0	0
„ howitzer carriage and limber 8 inch	14	2	16	0	0	0
„ „ „ „ dismounted „	10	2	12	0	0	0
„ „ „ „ heavy 5½ inch	10	2	12	0	0	0
„ „ „ „ dismounted „	6	1	7	0	0	0
„ „ „ „ medium 5½ in.	8	2	10	0	0	0
„ „ „ „ dismounted „	6	1	7	0	9	0
„ „ „ „ 12 pounder	8	2	10	0	0	0
„ „ „ „ dismounted „	6	1	7	0	0	0
Ammunition waggon Horse Artillery laden.	8*	2	10	0	0	0
„ „ „ „ empty	6	1	7	0	0	0
„ cart Foot Arty. „ laden	4	1	5	0	0	0
„ „ „ „ empty	2	1	3	0	0	0
Transport carriage spare. . . . . (With iron guns it will have the same number of cattle, allotted to those several calibers mounted.)	14	2	16	0	0	0

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* Vide G. O. G. 23d December 1831.

	In the Field.			From Station to Station.		
	In Yoke.	Spare.	Total.	In Yoke.	Spare.	Total.
Mortar cart spare.	6	1	7	0	0	0
When laden it will have additional cattle, in the following proportion. Additional cattle. Mortar. Bed. Total. 10 inch brass...... 6 6 12 8 ,, ,, ... 2 4 6 5½ ,, ,, ... 1 1 2 Spare cattle 1 to 5						
Forge cart, loads at 400 lbs. {empty laden}	4	1	5	0	0	0
Artificers cart, per bullock {empty laden}	4	1	5	0	0	0
Gun and mortar platforms, gins, &c. being carried on platform or country carts, will be laden as far as practicable in the proportions recently laid down in G. O. for such carts.						

The above Table is calculated at the rate of 240 lbs. weight for iron ordnance in the field, and at 400 lbs. for occasional movements; for brass ordnance the calculation is 400 lbs. weight, whether for field service or occasional movement.

The Military Board will be guided by the above rules, in calculating the allotment of cattle for ordnance carriages that may hereafter be introduced.

By order of the Right Honorable the Governor in Council.

(Signed) Robert Clerk,
Secretary to Government.

Extract from Artillery Orders, No. 240, dated St. Thomas's Mount, 7th February 1831.

The Military Board having authorized two breaks being allowed to each troop of Horse Artillery, and each company of foot artillery with bullocks attached, for the purpose of breaking in young cattle, the same is notified for general information, and Officers commanding will forward indents through the Director Artillery Depôt. New or good carriages are on no account to be used for breaking in horses or bullocks, and in the N. B. at the bottom of the Ordnance returns, the number of breaks with the detachment must be notified and the state they are in.

To the Acting Commandant of Artillery.

Sir,—I am directed to acknowledge the receipt of Lieutenant Colonel Pearse's letter of the 24th ultimo, requesting to be informed, if the indulgence granted to Gun lascars on re-admission to the corps of former service being included, was to be extended to such as might be entertained as drivers in the Karkhana establishment attached to the regiment of Artillery.

The Commander in-Chief in reply, has directed me to convey to you his authority for extending the same indulgence to Gun lascars of good character, and eligible in all respects, enlisted for any branch of the Artillery; but particularly enjoins you to the most careful selection of men for Drivers, as he considers the efficiency of the Artillery when employed on field service, must be intimately connected with the good or bad qualities of the men acting as drivers; and he is further of opinion, that no individual who has not been brought up from his infancy to the care and management of cattle, should be enlisted as a driver.

His Excellency therefore requests, you will ascertain from the several Officers of Artillery in charge of Karkhanas, whether the drivers generally speaking are of the *cow-keeper caste*, or of what cast and description these men are, reporting to this department for the information of the Commander-in-Chief, the result of your enquires.

(Signed) B. R. Hitchens,
Depty Adjutant General.

Adjt. Genl.'s Office :
Fort St. George,
3d *October* 1831.

Extract from Artillery Orders, No. 377, *dated Saint Thomas's Mount,* 22*d November* 1831.

The Military Board having authorized the issue of one platform cart with sides, for the occasional removal of Stores, &c., from local Magazines to the Artillery lines, for each regular Karkhana attached to the Regiment, Officers in charge will forward Indents for the same without delay, to the Director of the Artillery Depôt for the countersignature of the Commandant of Artillery, and submission to the Military Board.

Extract from Commissariat Regulations.

Table of daily allowance of forage and water to be issued to Draught bullocks on board ship.

Straw......................	15lbs.	each	per	day.
Chena or Gram............	2 Seers		,,	,,
Water..................	6 Gallons,		,,	,,
Pepper, as may occasionally be necessary for the health of the Bullocks but not to be more than..........	½ ounce	,,	,,	,,
Salt for occasional issues, at the rate of 2 seers per month.............	$\frac{1}{10}$ seer	,,	,,	,,
Baskets.....................	1 to every 2 Bullocks.			

G. O. by Government, No. 79, *Fort. Saint George,* 23*d March,* 1832.

The substitution of the light ammunition Cart, for the heavy waggon, having rendered it necessary to revise the Foot Artillery Karkhanas, as established in G. O. 23d September 1825; The Right Honorable the Governor in Council has been pleased to resolve, that the establishment shall hereafter consist of ten Companies or Karkhanas: seven, to have one Darogah, three Choudries, sixty-six Drivers, and one hundred and thirty two Bullocks each; and three, one Darogah, two Choudries, forty six Drivers and ninety-two Bullocks each.

G. O. C. C. 31*st October,* 1832.

With reference to the revised establishment for the Kharkanas attached to the Regiment of Artillery, fixed by Government in General Orders of the 23d March last, the Commander-in-Chief directs the following Distribution of them.

DISTRIBUTION.

KARKHANAS.	STRENGTH.				
	Bullock Serjeants.	Darogahs.	Choudries.	Drivers.	Bullocks.
No. 1 at Secunderabad	1	1	3	66	132
„ 2 at Nagpore......	2	2	6	132	264
„ 1 at Bellary.............	1	1	3	66	132
„ 1 at Bangalore.......	1	1	3	66	132
„ 1 at Trichinopoly......	1	1	3	66	132
„ 1 at Masulipatam.........	1	1	3	66	132
„ 3 at the Artillery Head Quarters.	3	3	6	138	276
Total Establishment....	10	10	27	600	1200

The Choudries and Drivers in excess of the new Establishment at the several stations, are to be directed to proceed immediately to the Mount, and the Commandant of Artillery on their arrival, will be pleased to form two new Karkhanas with as little delay as possible.

G. O. by Government, No. 62, *Fort St. George,* 22*d February,* 1833.

The Right Honorable the Governor in Council has been pleased to resolve, that a Karkhana consisting of one Darogah, three Choudries, sixty-six Drivers and one hundred and thirty-two Bullocks shall be added to the present establishment, and be employed with the field guns attached to the force on the Tenasserim Coast.

By order of the Right Honorable the Governor in Council.

(Signed) ROBERT CLERK,

Secretary to Government.

Extract from Artillery Orders, No. 419, *dated St. Thomas's Mount,* 19*th April* 1833.

The following Circular from the Military Board, is published for the information and guidance of the Officers of the regiment.

CIRCULAR.

MILITARY BOARD OFFICE.

To the Acting Commandant of Artillery.

Sir,—I have the honor under the orders of the Military Board to inform you, that as the new yokes in use with the regiment of Artillery, are all of one pattern, it is no longer necessary in indenting for them, to have a double column as at present is the case, under the two heads of "pole yokes," and "trace yokes," these terms are in consequence to be expunged and the term "yokes" substituted.

The gun carriages attached to the regiment of Artillery, are all of one muster for Horse and Foot Artillery, the only difference is, that to adopt them to the service of the former, they require a swivel only for the pole bar, whilst for the latter they require a swivel and band for the pole yoke.

As bands or yokes often require to be replaced whilst the swivels do not, the latter are to be considered as a separate article of store, and indented for as wanted. The swivels forming no part of the new muster yoke, or of the gun carriage.

FORT ST. GEORGE, 9*th April*, 1833. } (Signed) H. MITCHELL, *Act. Dep. Secy. Mily. Board.*

G. O. by Government, No. 178, *Fort St. George,* 28*th June* 1833.

The G. O. by Government of the 22d of February 1833, No. 62, allotting a Karkhana of draft cattle for the field guns in Moulmein is cancelled. Any cattle which may have been provided under that order, are to be made over to the Commissariat, and such drivers as have been entertained are to be discharged on their return to this coast.

By order of the Right Honorable the Governor in council.

(Signed) ROBERT CLERK,
Secretary to Government.

CIRCULAR.

To the Officer Commanding 1st Battalion Artillery.

Sir,—I have the honor by desire of the Acting Commandant of Artillery, to call on you for a statement of the usual monthly expense of Medicine furnished to the bullocks of the Karkhanas attached to the battalion under your command.

And, with reference to G. O. by Government dated 18th September 1827, you will be good enough to report for the Acting Commandant's information, the saving which has taken place, or could be effected in the monthly Indent, in consequence of the new organization of the different Karkhanas.

(Signed) R. G. Polwhele,
Asst. Adjt. Genl. of Artillery.

St. Thomas's Mount,
17th August, 1833.

CIRCULAR.

To the Officer in charge of Karkhana, No. 1 Secunderabad.

Sir,—I have the honor by order of the Commandant of Artillery, to request, that during the favourable season of the year, one half of the drivers of the Karkhana under your charge, may be employed in cutting and bringing in grass, each driver daily at least 28lbs. to be made into bundles, and paraded and inspected by you at evening stables, and afterwards dried and stacked by the men remaining in the lines.

2. During the season when grass is abundant, the Commandant of Artillery considers that by attention to the grazing of the Bullocks, and adopting measures to cause them to feed, Officers in charge of Karkhanas, could dispense with drawing the allowance of straw, and diminish the quantity of gram from 2 to 1½ seers, giving the good conditioned cattle only one seer, and the full allowance to the bullocks worked during the day or to those whose condition may require it.

3. During the period of the year when the cattle feed on green grass, it is very requiste that Officers in charge of Karkhanas should personally ascertain that the cattle receive their full allowance of salt; and establishing one day in the week for this purpose appears advisable, allowing each bullock to eat the salt unmixed, and forcibly causing such cattle to eat it, as are disinclined to take salt; mussal might likewise be given with the greatest advantage, but invariably in your presence, you may easily ascertain when bullocks are in want of salt, by observing that they drink little or no water.

4. I am further desired to request you will report to this office, what measures you adopt to give effect to the instructions conveyed in this letter, and to the 15th, 16th, and 17th paras. of G. O. G. under date 28th December 1825.

(Signed) G. Balfour,
Acting A. A. Genl. Artillery.

St. Thomas's Mount,
3d December, 1833.

G. O. by Government, No. 61, *Fort St. George*, 4*th February* 1834.

The Right Honorable the Governor in Council, is pleased to rescind the 16th, 17th and 18th paragraphs of the G. O. G. under date the 23d September 1825, and the G. O. G. of the 18th September 1827, and to direct that the following shall be substituted in their stead.

Each draft bullock is allowed 1½ seers of gram and 14lbs. of dry forage daily in cantonment, and 3 seers of gram and 14lbs. of dry forage in the field, or marching with guns and carriages, and half a seer of common salt per month; when dry forage is not procurable, double the weight of green is to be issued to the cattle. It will rest with Artillery officers to diminish the allowance of gram whenever the health of the cattle shall require it, or the abundance of forage may render any reduction advisable.

The dry forage for the use of the cattle in cantonments, will be provided at the most favorable season by the Commissariat, and delivered to the charge of the Artillery, no allowance being added to cover wastage. The gram shall in all situations be under charge of the Commissariat, and delivered out daily upon indents of the form annexed, which indents are to accompany the Commissariat accounts as vouchers for the quantity delivered during the month, and the Artillery Officers in charge, will be held responsible that the quantity of gram indented for, does not exceed the regulated allowance for the feed of the bullocks of their respective Karkhanas. General monthly returns shewing the strength on each day of each Karkhana, to be furnished at the end of every month, both to the Military Board, and Commissary General, to check the accounts of the officer issuing the gram. Returns of receipts and issues of forage to be made to the Military Board only. In the field, or when marching, dry forage will be furnished by the Commissariat daily, drivers being allotted from the Artillery Karkhanas for bringing in the same, and when green forage only is procurable, whether wild or cultivated, the drivers will necessarily cut and bring it in.

Each bullock to be allowed one full sized cumly-jhool annually, and the following articles to be supplied every fourth month by the Commissariat to each Karkhana, with reference to its number, as fixed by the G. O. G. of the 23d March 1832.

Articles.		To each karkhana of 132 bullocks.	To each karkhana of 92 bullocks.
Feeding gunnies (in convenient pieces) 18 inches broad.... feet.		90	62
Soaking skins ....No		4	3
Picketing ground rope (coir when procurable) fathoms		30	21
Of date rope, or cocoanut rope.	Leading rope.......yards	353	246
	Nose rope......... do.	198	138
	Neck rope......... do.	396	276
	Head rope......... do.	363	253
Of date, bamboo, or rattan.......	Large baskets...... No.	7	5
	Small baskets ..... No.	5	4

Indented on —— for the delivery of —— seers of gram for the use of —— bullocks of No. —— Karkhana, attached to the —— Company —— battalion artillery for the —— day of —— 1839.

	Number of Bullocks.	Allowance per each Bullock.	Gram or Chena.	Signature.
Artillery Karkhana.				

Station and
Date

A. B.
Commanding Company.

The abolition of the allowance of wastage of straw, to commence from the periods at which the next supplies are made, and the reduction in the quantity of gram from the 1st of March next.

By order of the Right Honorable the Governor in Council.

(Signed) HENRY CHAMIER,
Chief Secretary.

G. O. by Government No. 139, *Fort St. George,* 15*th April* 1834.

Several new grades having been established in the Army, since the publication of the G. O. G. 5th October 1813, the Governor in Council is pleased to publish for general information, the following revised list of persons entitled to receive rice in garrison as fighting men, and as public followers, or compensation in lieu thereof when not issued.

In the proportion of one seer of rice or two seers of paddy per man per day.

Drivers attached to the Companies of Karkhanas of Artillery draught bullocks.

Extract from Artillery Orders, No. 443, *dated St. Thomas's Mount,* 25*th June* 1834.

Under instructions from the Military Board, officers in charge of Karkhanas are requested to transmit to the officers of the Commissariat department, on the 1st of November of each year, a memorandum shewing the number of cattle attached to each Karkhana, with the quantity of dry forage remaining under their charge, with a view of those officers being informed, of the probable quantity it will be necessary to lay in for the next season.

Extract from Artillery Orders, No. 447, *dated St. Thomas's Mount, 4th August* 1834.

The Military Board having authorized the issue of one platform cart with sides, for the occasional removal of stores, &c. from local magazines to the Artillery lines for each regular Karkhana attached to the regiment, officers in charge are held answerable that no other use is made of them, carrying mud and stones, or water casks in them, is strictly forbidden.

The carts to be returned in like manner with the carriages.

G. O. by Government, No. 349, *Fort St. George,* 25 *th October,* 1834.

The Right Honorable the Governor in Council is pleased to direct, that from and after the 1st November next, the batta of the undermentioned public followers be fixed at one Anna per diem. viz.

Darogahs, } Attached to the Foot Artillery
Choudries, } Karkhana Bullocks.
Drivers, }

To His Excellency Lieut.-General the Honorable
Sir W. O'CALLAGHAN, K. C. B,
Commander in Chief, &c. &c. &c.

Sir,—I have the honor, in the absence and under the instructions of the Commissary General, to acknowledge the receipt of the Acting Deputy Quarter Master General's letter dated the 17th instant, with its accompaniments and to report to your Excellency, that the Officer of this Department at Bangalore, has been directed in communication with Captain Seton and the Collector of Northern Arcot, to take charge of the Bullock and to sell it to the Butchers for slaughter, or in the event of no purch er appearing, to destroy it.

2. I take this opportunity of respectfully submitting to your Excellency, whether it may not be expedient to issue general instructions to officers in charge of Artillery Karkhanas, for the immediate destruction of the animal in all cases of a similar kind occurring hereafter, as cattle which have had their legs broken will never again become fit for service, and only incur an unnecessary expense to Government, by keeping them awaiting instructions for their disposal.

(Signed) A. Tulloch, Major,
Depy. Commissary Genl.

Commissary Genl.'s Office,
Madras, 22d January 1835.

Extract from C. O. dated St. Thos's. Mount, 24th Jan. 1835.

The following is published.

CIRCULAR.

To the Officer Commanding Centre Division.

Sir,—I have the honor by desire of His Excellency the Commander-in-Chief to request, that you will be pleased to intimate to Artillery Officers under your command, that when marching from one Station to another, it shall so happen that any of the Gun bullocks under their charge shall injure themselves so severely, as, (in their opinion) to be rendered unfit for future Service, and no opportunity offers of immediately holding a Committee on the animal, they will forthwith destroy it, and report the circumstances attending the injury and its nature, to Head Quarters, instead of (as in recent instances) keeping the animal until they can hear from hence, and thereby incurring unnecessary expense to Government.

The annexed copy of a letter from the Deputy Commissary General, relating to a case in point, is transmitted for your information and guidance.

Fort St. George,
30th January, 1835.

(Signed) W. Butterworth,
Acting Dep. Qr. Mr. General.

G. O. G. No. 113; *Fort St. George,* 17*th March* 1835.

After the expiration of existing Contracts for Forage, the stock collected for the use of the Karkhana bullocks, attached to companies of Foot Artillery, will remain in charge of the Department of supply, and issues will be made daily or weekly, (as Commandants of Stations may determine in communication with the respective Commissariat Officers) on receipt for each separate quantity, the receipts to be taken up monthly and a regular indent corresponding with the quantity supplied, to be substituted as the voucher on which the charge may be entered in the Commissariat Returns and Journals.

Officers of Artillery will continue to render the returns and journals of receipts and issues of forage as at present to the Military Board, and the removal of the Forage from the stores of the Contractor or Commissariat as the case may be, if situated within a reasonable distance of the Artillery lines, will be effected by means of the public cattle and followers attached to the Artillery.

(Signed) ROBERT CLERK,
Secy. to Government.

Qr. Mr. Genl.'s Office,

To THE COMMANDANT OF ARTILLERY,
St. Thomas's Mount.

SIR,—I have the honor by desire of His Excellency the Commander-in-Chief, to forward for your information, the annexed copy of a letter from Government of the 5th instant.

By reference to the monthly returns, and by the proceedings of a Committee of the 5th instant from Bangalore, I find the number of cattle wanting to complete the various Karkhanas as mentioned in the margin,* and I am to acquaint you, it is proposed to recommend to Government, that a similar number shall be allotted from the Karkhana now ordered to be reduced, instead of sending them to the depôt at Mysore.

St. Thos's. Mount....	2
Bellary...............	11
Trichinopoly..........	14
Nagpore...............	37
Bangalore.............	10
Total..........	74

FORT ST. GEORGE,
12*th May,* 1835.

(Signed) W. STRAHAN, Major,
Actg. Qr. Mr. General.

Military Department.

TO HIS EXCELLENCY LIEUTENANT GENERAL THE HONORABLE SIR R. W. O'CALLAGHAN, K. C. B. COMMANDER-IN-CHIEF.

SIR,—Para. 1.—I am directed to acknowledge the receipt of a letter from the Acting Quarter Master General of the Army, dated the 18th March last No. 79, and to acquaint your Excellency, that the Government resolved to reduce the Karkhana of Artillery lately maintained at Masulipatam; as its services are not necessarily required at Secunderabad, and cattle for the movement of a Brigade of guns are always procurable in the vicinity of Vizagapatam.

2.—The bullocks will be returned to the depôt at Mysore, and the drivers discharged.

FORT ST. GEORGE, *5th May* 1835.

(Signed) ROBERT CLERK,
Secy. to Government.

Extract from A. O. dated St. Thomas's Mount, 3rd August 1835.

1. Government having ordered the reduction of Karkhana No. 7, lately stationed at Masulipatam, and which arrived at head quarters on the 31st ultimo, the Darogah, Chowdries and Drivers, will be borne as supernumeraries on the strength of Karkhana No. 8, from this date until otherwise disposed of, and the Officer Commanding the 3d Battalion, will be pleased to prepare Discharge certificates for the supernumerary drivers, agreeably to nominal rolls which will be furnished to him from the Assistant Adjutant General's office.

The 73 bullocks arrived with the above Karkhana, are drafted as follows, to complete the other Karkhanas to the established strength, and the 20 surplus to be handed over this evening to the chowdry of the Commissary General ordered to receive them.

To complete Karkhana No. 5 at Bangalore....	11	bullocks.
To complete Karkhana No. 6 at Trichinopoly..	24	do.
To complete Karkhana No. 9 Head Quarters 2d battalion Artillery....................	15	do.
To complete Karkhana No. 8 Head Quarters 3d battalion........................	2	do.

To complete Karkhana No. 10 Head Quarters 4th battalion	1	bullock.
To be handed over to the chowdry of the Commissariat department	20	do.
Total	73	do.

Extract from A. O. No. 481, *dated St. Thomas's Mount, 24th July* 1835.

Artillery Karkhanas are to be considered as attached to battalions, in the same manner as Gun lascars, and distributed as follows.

Karkhanas.	Corps.	Stations.
No. 1	1st Battalion	Secunderabad.
,, 2		Kamptee.
,, 3		Kamptee.
,, 4		Bellary.
,, 5	2d Battalion.	Bangalore.
,, 6		Trichinopoly.
,, 9		Mount.
,, 7	3d Battalion.	Mount.
,, 8		Mount.
,, 10	4th Battalion	Mount.

All reports, removals, alterations, &c. in Karkhanas to be made through Officers commanding corps, to which they are attached.

On the relief of a Company, the Karkhana attached to it may not be removed from the station, it will in this case be transferred to the relieving company, and in the event of a company being relieved by one of a different battalion, the removal of a Karkhana from one battalion to another will appear in Artillery orders.

All records and documents connected with a Karkhana, are not to be mixed up with the records of the company to which it may be attached, but kept distinct and separate.

Extract of a letter from the Secretary to Government to the Commander-in-Chief.

No. 2779, *dated* 18*th September* 1835.

Para. 4. " I am instructed to request your Excellency's " opinion upon the description of warm clothing that would " be best adapted for the use of this Corps when proceeding " on Service beyond Sea."

(Signed) S. W. Steel, *Lt. Colonel,*
Sect. to Govt. Mil. Dept.

Extract of a letter from the Adjutant General of the Army, to the Brigadier Commaudant of Artillery, dated 10*th October* 1835.

" Adverting to para. 4 of the letter from the Secretary to " Government, I am directed to request you will state your " opinion, as to the description of warm clothing best adapted for the use of the Drivers, when employed on foreign " service."

(Signed) T. H. S. Conway,
Adjutant General.

Extract from A.O. dated St. Thomas's Mount 12*th July* 1837.

Under instruction from Army Head Quarters, Karkhana No. 10 consisting of the following strength to be held in readiness to embark for Moulmain at the shortest notice.

Bullock Serjt.	Darogah	Chowdries	Drivers	Bullocks.
1	1	2	44	88

The Officer Commanding 4th Battalion, will be pleased to prepare Family certificates for such of the above individuals as may require them, and all other papers connected with the Karkhana as early as practicable.

G. O. G. No. 175, *Fort Saint George,* 19*th September* 1837.

The Governor in Council is pleased to direct, that the Karkhana of Artillery (No 7) formerly maintained at Masulipatam and reduced on the removal of the company of European Artillery from that station in 1835, shall be re-organized and attached to the Artillery in Malabar and Canara.

This Karkhana will consist of 1 Darogah, 3 Chowdries, 66 Drivers and 132 Bullocks.

(Signed) S. W. Steel, *Lt. Colonel,*
Sect. to Government.

G. O. G. No. 181, *Fort Saint George, 26th September* 1837.

The Governor in Council is pleased to sanction the addition of a Karkhana of 132 bullocks, with the regulated number of attendants, to the establishment of the Artillery, to replace a Karkhana recently sent from St. Thomas's Mount to Moulmain.

(Signed) S. W. Steel, *Lt. Colonel,*
Sect. to Government.

Extract from Artillery Order, No. 519, *dated Saint Thomas's Mount, 4th October* 1837.

The cummerbunds of Drivers not being uniform in all the Karkhanas, the Brigadier Commandant of Artillery publishes the following directions regarding them, which are to be strictly adhered to.

The cummerbund to be of red cotton cloth, six inches in breadth with a slight fringe at both ends, knotted, and one inch in length, the cords to be secured by three rows of narrow plaits above the fringe.

The cummerbund to go twice round the body on the natural waist, just above the hips, to be worn double tied on the right side, the ends hanging down in front of the right thigh, and one foot in length, from the tie.

Extract from Artillery Orders, dated Saint Thomas's Mount, 14th October 1837.

With reference to General Orders by Government, dated 19th and 26th September 1837, No. 175 and 181, the increased Establishment of two additional Karkhanas for the Regiment consisting of the undermentioned strength will be numbered 7 and 11 and posted to Corps and Stations as follows.

Rank.	Corps.	Station.	ESTABLISHMENT.				
			Bat. Serjt.	Darogah.	Chowdry.	Drivers.	Bullocks.
No. 7	4th Bn.	Cannanore.	1	1	3	66	132
No. 11	4th Bn.	Mount....	1	1	3	66	132
		Total.	2	2	6	132	264

G. O. G. No. 214, *Fort St. George,* 28*th November* 1837.

The Right Honorable the Governor in Council is pleased to notify for general information, that Gun lascars and ordnance drivers are eligible to the additional pay for length of service, granted to troops of the line by Government General Orders of the 2d May last.

Extract from Minute of Council, dated 12*th March* 1839.

The following general rules have been established for the measurement and fitting up of vessels when employed for the conveyance of Artillery Karkhana cattle, and they are never to be deviated from, except on emergency and under special sanction.

1. Seven feet in depth from the side of the ship, to the centre, by two and a half feet in breadth along the side of the ship, clear between the stancheons, is to be allotted to each bullock.

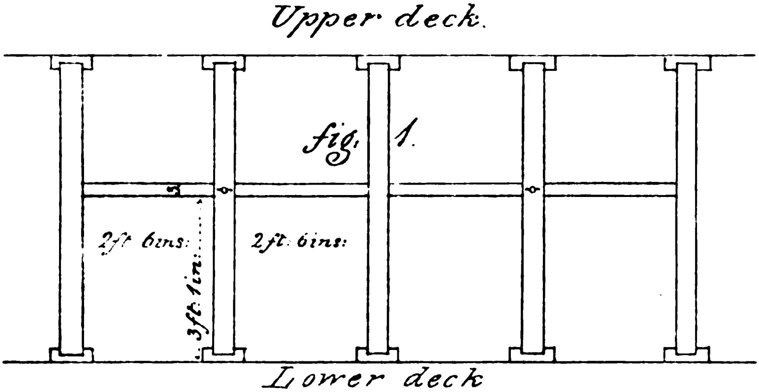
2. The minimum height of the decks, measured from the lower deck to the beams in the upper, is not to be less than five feet eight inches.

3. Bullocks should not be placed so close to the bows or stern, as to deprive them of a free current of air, and it would be adviseable, rather to leave vacant, a space of ten or twelve feet at each end of the ship, and place the cattle (which might have occupied this space) in the centre near to, or between the hatchways, and between the two side rows of bullocks.

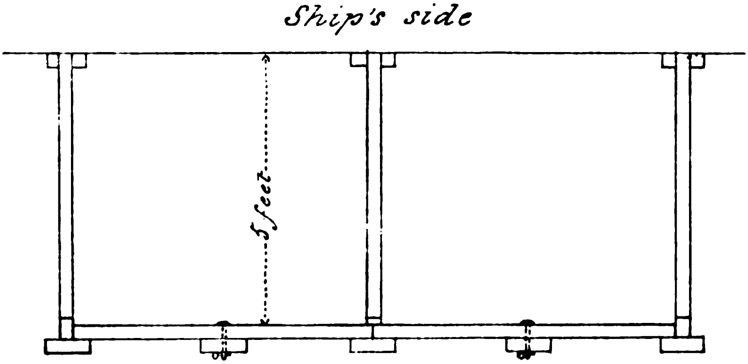
Karkhanas.

Plan and Elevation shewing the method of fixing the bars and stancheons for Bullocks on Ship Board.

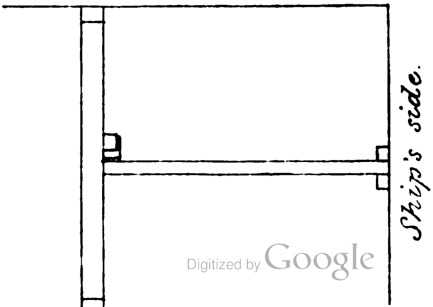
Front Elevation



Plan.



Side.



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FORMS

FOR THE CODE OF

REGIMENTAL

ORDNANCE REGULATIONS

NOW PREPARING AT THE

ARTILLERY DEPOT

UNDER THE SANCTION

OF

THE BRIGADIER COMMANDANT OF ARTILLERY

1844.

2

FORM No. 1.

RETURN of the Ordnance and Carriages in use with ____________________ *Artillery*
at ____________________ *for the Quarter* ____________________

Ordnance and Carriages.	Progressive Number.	Calibre.	Numbers and Marks.	Weight.			Length.		Diameter of			Cast or made.			When and whence received.	When last repaired or Painted.	Pattern of Carriage.	State of Ordnance and Carriages.					REMARKS.
				cwt	qrs.	lbs.	Feet	Inches.	Bore. Vertical	Bore. Horizontal	Vent.	Year.	Where	By whom				Serviceable for Field Service.	Repairable for Field Service.	Serviceable for Drill and Exercise.	Repairable for Drill and Exercise.	Unserviceable.	
									Inches.	Inches.	Inches.												
																							Here enter all Changes during the past quarter, whether of repairs or exchanges.

Station ____________________
Date ____________________

(Signed) ____________________ Captain
Commanding —— Company —— Battn. Arty.

(Signed) ____________________ Lt. Colonel
Commanding —— Battn. Arty.

NOTE.—This Return is forwarded with the Quarterly Returns, through Officers Commanding Brigades or Battalions—Vide A. O No. 459 dated 15th Feb. 1835. *All* wheel Carriages in use to be inserted, viz. Carriages, Waggons, Limbers and Carts, of all kinds.

FORM No. 2.

Quarterly Return *of Ordnance, Arms, Accoutrements, Ammunition, and* Stores *in use with the* ______ *Artillery ; shewing the Receipts and Issues for the Quarter ending* ______

Strength. Non-Comsd. Rank & File—Howitzers—Guns—Carriages—Waggons—Carts—Lascars—Artificers.

ARTICLES.	Remaining on the			Received			Total			Issued			Remaining on the			Allot-ment.	Remarks.
	S	R	U	S	R	U	S	R	U	S	R	U	S	R	U		

Station ______

(Signed)

Date ______ (Signed) ______ Lt. Col. ______ Captain.

Comg. —— Bat. Arty. Comg. — Compy. — Bat. Art.

Note.—A duplicate of so much of this Return as includes *Ordnance* and *Ordnance Stores*, is also forwarded for deposit in the Artillery Depôt. Vide A. O. No. 444 dated 8th July, 1834. The receipt and issue of Blank returns to be entered in that portion of the return sent to the Artillery Depôt—Also in an N. B. at the foot of the return the No. and dates of all Circulars received from the Artillery Depôt.

FORM No. 3.

Quarterly Journal *of Military* Stores *in use with the* ——— *Artillery, shewing the Receipts and Issues from* ———

Year and Month.	Date.	RECEIPTS.	Serviceable.	Repairable.	Unserviceable.	Year and Month.	Date.	ISSUES.	Serviceable.	Repairable.	Unserviceable.

Station ———
Date ———

(Signed)
——— *Lt.-Col.*
Commanding —— *Bat. Arty.*

(Signed)
——— *Captain*
Commanding —— Compy. —— *Bat. Arty.*

FORM No. 4.

PROCEEDINGS *of a Committee of Survey assembled at the Store Room of the* —————, *agreeably to* G. O. C. C. 17*th December,* 1840 *by order of Major* ——— *Comg. Arty.*———

ARTICLES.	Found on Examination.						Explanation of the Qr. Mr. for the surplus or deficient articles.	Remarks of the Committee.
	Surplus.			Deficient				
	S	R	U	S	R	U		
Belts, bayonet, musket...	10	..	..	...	..	...		
Muskets..................	. .	...	..	2	..	..		
Cartridges shotted musket	50	50	...	.	...	..		
Mamooties with helves ..	..	...	..	.	2	...		
Iron.................lbs.	...	...	..	3	...	...		

The Committee Certify, that the state of the Arms, Accoutrements, Stores, &c., in charge of Lieut. ————— Quarter Master of the Regiment, correspond with the Return and Journal for the quarter ending —————, with exception of the above Articles, found surplus and deficient.

(Signed)

Station__________ __________ Capt. & President.

Date__________ __________ Lieut. & Member.

__________ Lieut. & Member.

NOTE.—1. The Annual Committee to be assembled as soon after the 30th April in each year, as convenient; and the Proceedings to accompany the Returns for that Quarter.

2. This Form is also applicable, on the occasion of Special Committees, which may be held with reference to G. O. G. 23d August, 1836.

FORM No. 5.

PROCEEDINGS *of a Committee of* Survey *assembled at the* Store *Room of the* ————, *agreeably to* G. O. C. C. 17*th December,* 1840, *by order of Capt.* —— *Comg. Arty.* ——

The Committee proceed to examine the Arms, Accoutrements, Ammunition, Stores, Barrack Appurtenances, &c. in charge of Lieutenant ———— Quarter Master of the Regiment, as compared with the Regimental Return and Journal for the quarter ending ————, and Certify that they are found correct, there being neither surplus nor deficiency.

(Signed)

Station ____________ ____________ Capt. & President.

Date ____________ ____________ Lieut. & Member.

____________ Lieut. & Member.

NOTE.—1. The Annual Committee to be assembled as soon after the 30th April in each year, as convenient; and the Proceedings to accompany the Returns for that Quarter.

2. This Form is also applicable, on the occasion of Special Committees, which may be held with reference to G. O. G. 23d August, 1836.

FORM No. 6.

Extract from the Proceedings of an European Court of Enquiry, held at——— on ——— the — day of ——— One thousand Eight hundred and ——— by order of ——— Commanding Artillery ——— to ascertain how a Sword and Scabbard in possession of ——— became unserviceable.

PRESIDENT.

Captain ______________ Horse Artillery.

MEMBERS.

First Lieutenant ———— Horse Artillery.

—,, ——,, —— ————— — ,, —— ,, ——

The Court having assembled, proceed to investigate the cause of a Sword and Scabbard being broken, in the possession of ______________.

Serjeant______________ states that ——was in my Detachment at Drill, on —— morning, the —— of ——; he was a right file; on the order for dismounting for action, the horse of the left file made a kick at ————'s horse and struck the scabbard of his sword, which was broken by the blow. I reported the circumstance.

The Court is of opinion that the sword and scabbard were broken by an unavoidable accident, and that no blame whatever is to be attached to ___________

(Signed)

___________ Capt. and Pesident.
___________ Lieut. and Member.
___________ Lieut. and Member.

(A true Extract)
(Signed)

Station ___________ ___________ Captain

Date ___________ Commanding —— Troop H. A.

Note.—1. A Court of Enquiry on Arms, &c., injured, is for the purpose of placing on record that no blame attaches to the Soldier, and the decision is sufficient to support the Indent for exchange.

2. If blame attaches to the Soldier for carelessness or neglect, he may from his previous good conduct, be permitted to pay voluntarily for the Article; a declaration signed by him, (Form No. 7.) to be inserted at the foot of the Proceedings of the Court of Enquiry, otherwise the Confirmned Proceedings of a Court Martial to be attached in support of the Indent.

3. In the heading of the Proceedings, the Christian names of the Officers detailed, to be inserted in full.

FORM No. 7.

I, the undersigned, Gunner ________________ General No. ——— of the ——— Company ——— Battalion Artillery, do hereby request to be put under stoppages for the payment of a Bayonet lost by me; to avoid a Court Martial.

Station __________ (Signed)

Date __________ __________________

(Signed)

______________ Capt.

3d Battn. Artillery

President Court of Enquiry.

Note.—The Paymaster's Receipt for money paid to him on account of Arms, &c. &c., to be forwarded to the Secretary Military Board, through the Director Artillery Depôt, with a *letter*, and not with the Quarterly Returns.

FORM No. 8.

INDENT *on the Commissary of Ordnance at ——————, for the delivery of the following Articles, for the service of the ———.*

Strength.		ARTICLES.	Number in Store.	Number indented for	Cause of deficiency and for what purpose wanted.	Admitted of and ordered to be supplied.
Guns Howitzers Carriages Waggons Carts.	Rank and File	Gunpowder corned ...C. P.... lbs.			For the Practice and Exercise of the ——for the year during the year	
		do do ....M.P .. do				
		Shells, common fixed to grummets pdrs.				
		Shot round do do do				
		do canister Howitzer .... do				
		do do Gun .... do				
		Cartridges serge empty Howitzer. do				
		do do do Gun...... do				
		Bags, starting common Shells..... inch				
		Portfires, drove.. .... No.				
		Fuzes, drove common.. .... inch				
		Match, cotton .... skeins				
		do quick .... do				
		Curtains, cloth, complete with bamboos, rope and pegs—feet, by				
		Twine, country.................. skeins				
		Bamboos, common................ No.			For the Repair of Curtains ——	
		Coconnut Shell, burnt....... .... lbs.				
		Cloth, coarse .... cubits				
		Thread, cotton............ ... oz.				
		Needles, sewing................ No.				

Station ——————— (Signed)

Date ——————— ——————— Capt.

(Signed) Comm'dg.——Company—Battn. Arty.

——————— Lieut. Col.

Commanding ——— Battn. Arty. or Arty. at ——

NOTE.—Should be despatched so as to reach the Artillery Depot on the 25th November in each year; Vide A. O. No. 411, dated 3rd February, 1833.

FORM No. 9.

Indent *on the Commissary of Ordnance at* ——————
for the delivery of the following Articles for the service of the
—— *Company* —— *Battalion Artillery.*

Strength.	ARTICLES.	No. in Store.	No. indented for	When in use	Cause of deficiency and for what purpose wanted.	Admitted of, and ordered to be supplied.
Guns —— Carts. Non-commissioned—Rank and File ——	Cartridges shotted Percussion... .... Musket				For the Practice of the Company during the year 18 — at 36 rounds of shotted, and 60 rounds of Blank ammunition per Man.	
	do do Flint do.					
	Caps Percussion Copper... .... No.					
	Flints Musket...					
	Gunpowder M. P.... .. lbs.					
	Paper Cartridge... quires.					
	Flints musket					
	Caps percussion copper........... ...... No.					
	Twine Country .... sks.					
	Barrels packing.... .					
	Cloth dungaree....... yds.				For the repair of Targets for small arm Practice for the year 18 —	
	Needles sail......... ...					
	Brushes Cocoanut.....					
	Cocoanut shell burnt lbs.					
	Twine Country........ sks.					

Station ————
Date ————

(Signed)
———— Captain,
Comg. —— Company —— Battn. Arty.

(Signed)
———— Lieut. Col.
Commanding —— Battn. Arty. or Artillery at ——

Vide Note to preceding Form.

FORM No. 10.

Indent *on the Commissary of Ordnance ——— at for the delivery of the following Articles for the Service of the ———.*

Strength.		ARTICLES.	No. in Store.	No. indented for	Cause of deficiency and for what purpose wanted.	Admitted of and ordered to be supplied.
Carriages Waggons. Carts.	Rank and File.					
		Oil, cocoanut.....meas.			For the preservation of Ordnance and Carriages for the quarter ending. ———	
		Cloth, white.......yds.				
		„ waxed........ „				
		Emery... ....lbs.				
		Needles..........No.				
		Tar and Grease, mixed..............Gals				

Station ——— (Signed) ——— Captain.
Date ——— Comdg. Troop H. B.
(Signed) ——— Lieut. Col.
Comdg. Artillery.

Note—Should be despatched from Stations so as to reach Artillery Head Quarters by the 1st February, May, August, and November, for the quarter in advance; A. O. No. 411, dated 3d February 1833.

FORM No. 11.

Indent *on the Commissary of Ordnance at ——— for the delivery (and exchange) of the following Articles for the Service of the ———*

Strength.		ARTICLES.	No. in Store.	No. indented for.	When in use.	Cause of deficiency and for what purpose wanted.	Admitted of and ordered to be supplid.
		To be entered under the same heads in which they are classed in the returns.					

Station ——— (Signed) ——— Captain.
Date ——— Comdg. — Compy. — Bat.
(Signed) ——— Lieut. Col.
Comdg. Artillery.

Note.—*When articles are indented for in exchange the following is added:*

I certify that the above articles requiring to be exchanged, to the best of my knowledge, and according to every enquiry that I could make, were damaged not wantonly but in consequence of unforeseen and unavoidable accidents, (or on actual service.)

FORM No. 12.

INDENT *on the Director of the Artillery Depôt for the following Blank Forms for the ———— for the half year ending, ———*

FORMS.	Number remaining.	Number required.	REMARKS.
†Return and Journal of Ordnance, Arms and Accoutrements, Ammunition and Stores..........			
† „ of Ordnance, Ammunition and Stores..................			
† „ „ and Carriages.........			
„ of Bullocks...............			
„ of Draft Bullocks........			
„ of Picketing ropes, &c.....			
† Indents for Petty Stores.......			
† „ „ Ordnance Stores. .large			
† „ „ „ „ ..small			
„ for Salt..................			
„ for Forage..............			
† „ Annual...............			
„ Daily for gram..........			
† „ for Blank Forms...........			
Account of Daily Expenditure of Forage and Gram.............			
„ of Receipts and Issues....			
Receipts for Gram.............			

Station ________ (Signed) ________ Captain.

Date ________ Comdg. — Compy. — Bat. Art.

NOTE—Officers Commanding Troops of Horse Artillery, Indent for those Forms marked†.—This indent is prepared on a quarter Sheet of Foolscap.

FORM No. 13.

PROCEEDINGS *of a Committee of Survey on the Arms, Accoutrements, and Stores of the ——— assembled by order of Major ——— Commanding Artillery ———*

Captain ——— President.

Lieutenant ——— and Lieutenant ——— Members.

Examined the Arms, Accoutrements and Stores of the ——— when they were found in the following state.

Articles.	Number to be examined.	State in which they are found by the Committee.			Time they have been in use with the	REMARKS.
		Serviceable	Repairable	Unserviceable		
						This column to shew the nature of repairs required to each article returned Repairable, and whether the repairs can be executed on the spot.

Station ———
Date ———

(Signed)

——— Major
Commanding Artillery.

(Signed)

——— Capt. & President
——— Lieut. & Member.
——— Lieut. & Member.

NOTE.—Vide Note 3 to Form 6.

The articles submitted for survey are to be entered in the Proceedings under the same heads, as they are classed in the Quarterly Returns.

FORM No. 14.

Ordnance in use with the ________________ *surveyed by a Committee of Inspection on the* ____________ *by order of Captain* —— —— *Commanding Artillery at* ——

ORDNANCE	No. on the	Weight.			Length.		Cast.			Diameter of					Bouched.			State.			REMARKS.
										Bore		Chamber at entrance.			Metal						
		cwt.	qrs.	lbs.	feet.	Inches	Year.	Where.	By whom.	In. Horizontal	In. Vertical	In. Horizontal	In. Vertical	In 1 Vent.	Copper.	Iron.	When last bouched.	Serviceable	Repairable.	Unserviceable.	

Station and Date
(Sigued) ____________ Capt.
Commanding Artillery.

(Signed)

____________ Captain & President
____________ Lieut. & Member.
____________ Lieut. & Member.

Note.—When Ordnance require bouching, or are considered unserviceable, this Form to be used, in making the Report to the Director Artillery Depôt.

FORM No. 15.

REPORT *of a Proof of the undermentioned Guns, rebouched at the* ____________ *by order of* ____________ *Commanding Artillery* ______

Station and Date ____________

NATURE OF ORDNANCE.	No. of Guns.	No. of Firings.	Nature and strength of Powder.	Marks on the Ordnance.	Marks on the Carriages.	WEIGHT OF										Elevation.		Recoil.		Time in Firing.	Remarks.
						Metal.			Carriage.			Charge.		Shot.							
						cwt.	qrs.	lbs.	cwt.	qrs.	lbs.	lbs.	oz.	lbs.	oz.	deg.	mts.	feet	inch.		

Station ______
Date ______

(Signed) __________ Lieut. Colonel.
Commanding Artillery.

(Signed) __________ Captain.
Superintending Proof.

FORM No. 16.

Proceedings *of a Committee of Survey held agreeably to Orders by Major* ____________ *Commanding Artillery at* __________, *to examine and report on the Repairs made to the following Carriages.*

Captain ____________ President.

Lieut. __________ and Lieut. __________ Members.

The Committee having assembled agreeably to Orders, proceed to examine the undermentioned Carriages, &c. which have been repaired.

Description.	Number.	Marks.			Weight.			State.					Remarks.
		Initial Letters.	Year.	No.	Cwt.	Qrs.	lbs.	Serviceable for Field Service.	Repairable for Field Service.	Serviceable for Drill and Exercise.	Repairable for Drill and Exercise.	Unserviceable.	
Carriage Gun 9 Pdr....													Here enter all particulars as to the Repairs executed.
Limber ,, ..													
Carriage Howitzer 24 Pdr..													
Limber ,, ...													
Waggon Ammunition 9 Pdr.													
Limber ,, ...													

Station __________ (Signed)

Date __________ __________ Capt. & President.

(Signed) __________ Lieut. & Member.

__________ Major. __________ Lieut. & Member.

Comdg. Arty. ________

Vide Note 3 in Form 6.

FORM No. 17.

Return *of Books of Regulation and Instruction in use with the ——— Artillery.*

Names of Books.	Number.	When received.	Head Qrs. Staff.	Troop or Company.				Wanting to complete.	Remarks.
				A	B	C	D		
To be arranged Alphabetically. Vide A. O. No. 472, dated 15th May 1835.									The state or condition, in which the Books are, to be inserted.

Station ———

Date ———

Signature of Officer Commanding Brigade or Battalion.

Note.—Officers Commanding Troops and Companies, furnish a Return of the Books in use with them, to Officers Commanding Brigades and Battalions: to be despatched on the 1st day of the month succeeding the Quarter.

FORM No. 18.

RETURN OF AMMUNITION, &c. *expended by the* ———— ———— *Artillery, at the capture of* ———————— *on the* ———— 18 —, *under the Command of Lieutenant Colonel* ————————.

ARTICLES.	No.
Cartridges Serge filled..............4⅖ inch Howitzer	
„ „ „ ....3 Pounder	
„ Cloth bursting................. 8 Ounce	
„ „ ....12 „	
„ „ ....4½ „	
„ „ filled.......5½ inch Mortar 9 Ounce	
Shells common loose........................5½ inch	
„ „ fixed.......... ....4⅖ inch Howitzer	
Shot Spherical case filled...........4⅖ „ „	
„ round fixed..........................12 Pounder	
„ „ loose......................... 3 „	
„ „ fixed......................... 3 „	
„ Canister.............................. 3 „	
Fuzes drove common..........................5½ inch	
„ „ „ ....4⅖ „	
„ „ spherical case shot...... ....5½ „	
Gunpowder priming..............................lbs.	
„ mealed............................. „	
Match quick.....................................skeins	
„ cotton.................................. „	
Portfires drove............................	

Station ———— (Signed) ———— Lieut. Col.

Date ———— Commanding Artillery.

FORM No. 19.

Return of Ordnance *captured at* ——————— *on the* ——————— 18 —, *by the* ——————— *Artillery under the Command of* ———————.

Where.	Brass Guns.				Iron Guns.								Grand Total.
	6-Pounder.	9 "	24 "	Total.	3-Pounder.	4 "	6 "	9 "	12 "	18 "	24 "	Total.	
In Battery... ...No. 1	1	0	1	2	0	0	2	0	1	3	2	8	10
" " " . . " 2	2	1	0	3	2	1	0	2	1	0	1	7	10
" " " . . " 3	0	1	3	4	4	0	0	0	0	1	2	7	11
" the Arsenal....	4	2	4	10	6	2	3	2	1	1	1	16	26
Total. .	7	4	8	19	12	3	5	4	3	5	6	38	57

The Brass Ordnance has been embarked, and the Iron Ordnance destroyed.

A very large quantity of Ginjals, Matchlocks, Swords, Gunpowder, Shot, and other ammunitions of war taken and destroyed.

Station ———— (Signed) ——————— Lieut. Col.
Date ———— Commanding Artillery.

FORM No. 20.

General Table of Ordnance *and* Projectiles *used during the Practice at* ———————— *in the year 18 —.*

ORDNANCE.	WEIGHT OF						BORE.			CHAMBER.								SHOT ROUND			SPHERICAL CASE SHOT.						SHELLS COMMON.				
							Diameter.			Diameter.								Average.			Average.										
										superior.		inferior.										Weight.									
	Ordnance.			Carriage or Bed.			Horizontal.	Vertical.	Length of	Horizontal.	Vertical.	Horizontal.	Vertical.	Length of	Contents.		Shape.	Diameter.	Weight.		Diameter.	Empty.		Filled.		Musket ball.	Nature.	Number.	Diameter.	Weight, empty.	
	cwt.	qrs.	lbs.	cwt.	qrs.	lbs.	in.	in.	in.	in.	in.	in.	in.	in.	lbs.	oz.		in.	lbs.	oz.	in.	lbs.	oz.	lbs.	oz.	No.			in.	lbs.	oz.

Note.—The Ordnance and Projectiles should be carefully measured and gauged: the H and L gauges being applied to every Shell and Shot used.

(Signed) ———————— Lieut. Col.
Commanding Artillery.

FORM No. 21.

Report of a Proof of Gunpowder, *carried on at* ———————— *by order of Major* ———————— *Commanding Artillery; for the Annual Artillery Practice of* 18 —.

NATURE OF ORDNANCE.	Weight of Bed.			Mortar.													Ball or Shot Steel.				Elevation.
				Weight of			Length of		Bore.			Chamber.					Numbered.	Weight of each.		Diameter of each.	
									Length of	Diameter.		Shape.	Contents.	Length.	Diameter at entrance.						
										Vertical.	Horizontal.				Vertical.	Horizontal.					
	cwt.	qrs.	lbs.	cwt.	qrs.	lbs.	feet.	ins.	ins.	ins.	ins.		lbs.	ins.	ins.	ins.		lbs.	oz.	inches.	deg.

Note.—When proving Powder for Practice, it is advisable to use both a solid Shot, and a Shell as prepared for Practice, the former as a comparison with the original Proof, and the latter as giving a data for calculating charges. This Form to be used on all occasions of proving Gunpowder.

Ordnance.	Date.	No. of Firings.	No. marked on the ball.	Powder.				Flight.		Distance from the line of fire.		Range.		Musket charge 4¼ drachms, distance 30 feet--number of wet mango boards penetrated ¾ inch thick ¾ inch apart.		Height of		Weight contained in a copper measure 3'5 ins. in height and 3'5 inches in diameter.		Remarks.
				Nature and when made.	Weight of charge.		Original Proof.	sec.	pts.	Right.	Left.	Real.	Medium.	No. at ea. round.	Medium.	Thermometer.	Barometer.	ozs.	drs.	
					lbs.	oz.				yards.	yards.	yards.	yards.							
																				The strength and direction of the wind, the state of the weather during the Proof, and for the previous 12 hours, to be noted: whether the Powder has been dried, &c. also the time the Gunpowder has been at the station, how kept, whether in temporary, Field, or Permanent Magazines to be entered.

Station ——

Date ——

(Signed) —————— Captain.
Superintending Proof.

(Signed) —————— Lieut. Col.
Commanding Artillery ——

FORM No. 22,
8-INCH BRASS OR IRON MORTAR, No. 1.

Date.	No. of Firings.	Shell's No.	Weight of Powder.			Elevation.	Fuze.	Flight.		Fuze started.		RANGE.		DISTANCE.		Flag's distance.	Remarks.
												Right.	Left.	Real.	Medium.		
			lbs.	ozs.	drs.	deg	ins.	S.	P.	S	P	yards,	yards.	yards.	yards.	yards.	

NOTE 1.—The nature of Platform and whether the mortar has an Elevating Screw, &c. to be inserted here.

NOTE 2.—A separate Report for each mortar used at Practice is to be sent in. Each round fired to be inserted in the report.

(Signed) ———————— Captain.
Commanding Artillery ——

FORM No. 23.

Iron Gun.—No. 1.

Date.	No. of Firings.	Charge.		Elevation Medium.		Shot through the Target fromthe centre				Recoil Medium.		Target distance.	Remarks.
		lbs.	ozs.	D	M	Right.	Left.	Under.	Over.	Feet,	Ins.	yds.	

Note 1.—Nature and number of Wads used; kind of Platform, &c. to be inserted here.

Note 2.—A separate Report for each Gun used at Practice to be sent in, a medium of each day's practice only is required.

(Signed)________________ *Captain,*

Commanding Artillery.

FORM No. 24.

24 Pounder Brass Howitzer (Ricochêt.)

Date.	No. of Firings.	Charge.		Elevation.		Flight.		Fuze.	Grazes.	Times Traverses struck.	Recoil.		Distance from the Battery to the works.	Distance to 1st Graze.	Lodged in the works	Remarks.
		lbs.	oz.	D	M	S	P	ins.	Between Battery and Works.	No.	feet.	ins.	yds.	yds.		

Note 1.—A separate Report for each Howitzer used at Practice to be sent in.

Note 2.—The same Form answers for enfilade Practice. A medium of each day's practice only is required.

(Signed)__________________, *Captain,*
Commanding Artillery.

FORM No. 25.

Spherical Case Shot Practice.

Date.	No. of Firings.	Fuzes set by	Ordnance.	Weight of			Elevation.				Flight to shot's bursting.		Fuze.	Balls through			No. of balls in the Shells			Curtains distance.	Remarks.
				Each charge.			By Quadrant		By Tangent Scale.					1st Curtain.	2d "	3d "	That burst.	Not "	Total.		
				lbs.	ozs.	drs.	D	M	D	M	S	P	inch.							yds.	

Note.—Separate Reports are not required for each piece of Ordnance, but each round fired is to be inserted.

(Signed)________________, *Captain,*

Commanding Artillery.

FORM No. 26.

GENERAL OBSERVATIONS.

On the Practice carried on at ______________________________
in the year 18——.

Here enter

All observations and suggestions relating to Practice generally; or to the Practice at the Station.

Remarks on Stores generally, and on Laboratory Stores in particular.

The effects of the Practice on Carriages, &c. and full Remarks on such carriages as are injured.

Sketches of Fractures in Ordnance Carriages always to be forwarded with reports.

FORM No. 27.

Indent No.—— *on the Commissary of Ordnance at* ________________ *for the following Articles expended during the Annual Practice of the Artillery at* ________________.

Station and Date.

Number of Non-commissioned Rank and File.

Ordnance.

Guns Iron——18 Pounder——Mortars——8 inch——Inch
—„——„—— 12——„—————„ ——— 5½ „ —— „
—„ Brass—— 9——„ Howitzer Heavy 5½ „ —— „
Mortar „ —— 10 Inch______________

Articles.	Number Indented for.	For what purpose.	Admitted of

(Signed)______________ Captain.
Commanding __________Artillery.

Note.—The articles *expended* at Practice, to be indented for; those rendered repairable or unserviceable, to be returned into store.

FORM No. 28.

STORES.

Proceedings of *a Committee of Survey assembled by order of Major ——— ——— Commanding Artillery ——— ——— at the Practice Ground, ——— to examine and report on the Stores, &c. which have been in use with the Artillery, during the annual Practice of* 18——.

Captain...................... President.
Lieutenant................ } Members.
—— " —— .... }

The Committee having assembled agreeably to orders, proceed to examine the undermentioned articles which they find as hereafter described, and that the expenditure has been as follows:

ARTICLES.	Number Supplied.	State of Articles returned into store.			Expended.	REMARKS.
		S	R	U		
Axes Felling..............	6	3	3	0	0	Require new helves
Balls Fire Paper Drove, 8 inch	10	4	0	0	6	
" " " " 5½ "	10	4	0	0	6	
Bamboos common 18 feet long....................	16	0	0	16	0	Broken.
Brooms...........bundles.	20	0	0	0	20	
Buckets wooden water.....	20	0	0	20	0	Hoops much corroded and loose.
Carriers Iron for hot shot ..	4	0	4	0	0	Require painting.
Casks Packing	3	0	0	3	0	Hoops burst, and staves rotten.
Chalk.................lbs.	2	0	0	0	2	
Coal char.. .. .. bushels.	12	0	0	0	12	
Colors camp small.........	8	0	0	8	0	Iron and moth eaten.
Emery country........ lbs,	½	0	0	0	½	
Forks iron for hot shot.....	2	0	2	0	0	Points bent.
Fuzes drove common 10 inch	80	20	0	0	60	
" " " 8 "	150	30	0	0	120	
" " " 5½ "	550	40	0	0	510	
" " Sphl. case shot...	200	20	0	0	180	
Handspikes purchasing	24	8	0	16	0	Broken.
Instruments Pincers Fuze Brass............. pairs.	2	2	0	0	0	
" Perpendicular spirit	13	13	0	0	0	
" Quadrant common Mortar	8	0	8	0	0	Require new cases

(Signed.)——— ———Captn. President.
" ———————Lieut. Member.
" ——————— " "

(Signed) ———————Major.
Commanding ———————Artillery.

Note.—Vide note 3, form 6.

FORM No. 29.

ORDNANCE.

Proceedings *of a Committee of Survey assembled by order of Major* ———————— *Commanding the Artillery* ———————— *at the Artillery Practice ground* ———————— *to examine and report on the Ordnance Carriages, &c. which have been in use with the Artillery during the Annual Practice of* 18 .

Captain ———————— President.
Lieutenant ———————— } Members.
" ————————

The Committee having assembled agreeably to orders proceed to examine the undermentioned Ordnance, &c. which they find in the following state.

DESCRIPTION.	Number.	MARKS.			Weight			State.			REMARKS.
		Initial Letter.	Year.	No.	cwts.	qrs.	lbs.	S.	R.	U.	
Iron Gun....18 Pdr.	1	P S	none	none	41	1	12	1	0	0	
Carriage.....18 "	1	none	none	none	0	0	0	0	0	1	2 spokes right wheel broke.
Limber......18 "	1	J. M.	1810	4	0	0	0	0	0	1	Pole broke.
Brass Mortar.8 inch,	1	J.D.S.	1811	6	6	3	0	1	0	0	
Bed " ..8 "	1	none	"	0	0	0	0	0	1	0	2 forelock keys broken.
BrassHowitzerHeavy..........5½ in.	1	F. K.	1812	31	9	3	20	1	0	0	
Carriage......5½ "	1	W. C.	1827	1	15	0	16	1	0	0	
Limber...... .5½ "	1	none	"	0	0	0	0	1	0	0	
Brass Gun....9 Pdr.	1	T. 26 793	"	0	8	3	19	1	0	0	
Carriage......9 "	1	J.H·F	1835	15	11	3	20	1	0	0	
Limber.......9 "	1	J.H.F	1835	15	11	1	18	1	0	0	
Carts Mortar.......	1	W. C.	1824	27	0	0	0	0	1	0	1 plankonplatform broken.
" "	2	J.HF.	1835	43	18	1	12	0	1	0	1 spoke in left wheel broke.
Carts Platform.....	1	S.M.	1822	1577	0	0	0	0	0	1	old when issued, wheels require extensive repairs, platforms broken, and poles bad.
" "	2	J.M.	1823	1700	0	0	0	0	0	1	
" "	3	J.M.	1822	1687	0	0	0	0	0	1	

(Signed) ———————— Captain, President.
" ———————— Lieut. Member.
" ———————— " "

(Signed) ———————— Major.
Commanding Artillery.

Note.—Vide note 3 from 6.

FORM No. 30.

ABSTRACT OF *Repairs required to the Ordnamce Carriages in use with the* ——————— *Surveyed by a Committee of Inspection on the* ———————.

Nature of Carriages.	Number.	State.		Repairs Necessary.																												Makers name and marks.	When last painted.	Do. do. repaired.	Time in use.	Pattern.	Remarks.
		Repairable.	Unserviceable.	Cheeks.	Transoms.	Wheels.	Axletree.	Naves.	Brass Washers.	Elevating screw.	Draghook or washer.	Linch pins.	Painting.	Poles.	Limber boxes.	Splinter bars.	Fore lock keys.	Bolts.	Spokes.	Feilies.	Seats.	Garnish plates.	Nails.	Clamps.	Tire cutting.	Rings.	Limber boxes covering.	Do. lining and caulking.	Boxes nave brass.	Do. do. Iron.	Pole end socket.						
Total..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

(Signed.)——————Major.
Commanding—— ——Artillery.

NOTE.—Under the head "Repairs necessary" such columns only to be inserted as will include all the repairs required. An intelligent Artificer or Foreman from the Ordnance Department, should attend the Committee on these occasions.

FORM No. 31.

QUARTERLY RETURN *of* **ORDNANCE** *and* **CARRIAGES** *in charge of the Commissary of Ordnance at* ——— *for the Quarter ending*———
Station and date.

	ORDNANCE MOUNTED.								Spare ordnance			Spare Carriages.					Allotment	Sur-plus		Deficient		Carriages constructed in the following years.																								
	State of																																													
	Ordnance.			Carriages.																																										
	Serviceable.	Repairable.	Unserviceable.	S. for field service.	S. for drill exercise.	R. for field service.	R. for drill & exercise	Unserviceable.	Serviceable.	Repairable.	Unserviceable.	Serviceable for field service.	Do. for drill and exercise.	Repairable for field service.	Do. for drill and exercise.	Unserviceable.		Ordnance.	Carriages.	Ordnance.	Carriages.																									
Garrison Ordnance......																																														
Heavy Field..																																														
Light Field...																																														
Carts, &c.....																																														

(Signed)——— ——— ———Captain.
Commanding Artillery.

NOTE.—1. This form occupies the second and third pages of the sheet.

2. Ordnance Officers furnish this Return to the Officer Commanding Artillery on the 10th day of the month after each quarter. If no alteration has taken place in the preceding quarter, a memo. to that effect will only be sent, and a similar one sent to the Director of the Artillery Depôt.

3. All alterations during the quarter to be noted in an N. B. at the foot of the Return.

FORM No. 31—*continued.*

STATEMENT *of* PROJECTILES, GUNPOWDER &c. *in charge of the Commissary of Ordnance at* —————— *for the Quarter ending* ——————18——.

	Shot, Shells, &c.								Fuzes.		Gunpowder.							
					Carcasses.		Fireballs.											
	Round.	Canister.	Spherical case.	Shells.	Filled.	Empty.	Filled.	Empty.	Common.	Spherical case Shot.	L. G. lbs.	S. G. lbs.	F. G. lbs.	C. P. lbs.	M. P. lbs.	Mealed lbs.	Portfires.	Quick Match.
24 Pounder																		
18 „																		
12 „																		
9 „																		
6 „																		
3 „																		
13 Inch																		
10 „																		
8 „																		
5½ „																		
4⅖ „																		

Note.—This form is placed on the first page of the sheet of the Quarterly Return, Vide No. 31.

FORM No. 32.

Report *of a* **Proof** *of the undermentioned Light Field Carriages by order of Captain* ——————
Commanding Artillery —————— ———.

Nature of Ordnance.	No. of Carriages.	No. of Firings.	Nature and Strength of Powder.	Marks on the Carriages.	Marks on the Guns.	Weight of										Elevation.		Recoil.		Time in firing.	Remarks.
						Metal.			Carriages.			Charge		Shot or Shell.							
						cwt.	qrs.	lbs.	cwt.	qrs.	lbs.	lbs.	ozs.	lbs.	ozs.	D	M	ft.	ins.		

Station and date.

(Signed)—————— Lieutenant.
Superintending Proof.

(Signed)—————— Captain.
Commanding Artillery.

Note.—Should the Carriage suffer any injury, full particulars to be inserted in the column of Remarks, and a sketch of the fracture to accompany the Report.

FORM No. 33.

REPORT of a PROOF of Ordnance at ————————by order of Lieutenant Colonel ———— Commanding Artillery at ——— on the ———.

Nature.	Brass Guns.									Powder.													Round shot No.				Height the 1st charge measured.		Vertical diameter of bore at the muzzle.	Horizontal diameter of bore at the muzzle.	On the Returns			Recoil.		Remarks.	State after proof		
	Distinguishing mark.	Number.	Length.		Weight.			Nature.	When made.	For scaling.		For priming.		Charge.						Total quantity used.			Firings.			Total.					Serviceable.	Repairable.	Unserviceable.				Serviceable.	Repairable.	Unserviceable.
														1st.		2nd.		3rd.																					
			feet.	ins.	cwt.	qrs.	lbs.			lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	90lbs barrel	lbs.	ozs.	1st.	2nd.	3rd.		feet.	ins.	ins.	ins.				feet.	ins.				

Station and Date.

(Signed)———————Lieutenant.
Superintending Proof.

(Signed)———————Lieut. Col.
Commanding Artillery.

FORM No. 34.

DIMENSIONS OF CARRIAGES *for which Ordnance are required for —— Company —— —— Artillery at ——.*

Nature of Carriage.	Number and Mark.	When made.	From the centre of trunnion boxes to the centre of elevating screw.		Breadth between the cheeks at the trunnion boxes.	Diameter of right trunnion hole.	Diameter of left trunnion hole.	Remarks.
			feet.	ins.	inches.	ins.	ins.	

Station and Date. (Signed) —————— Lieut.
Comdg. —— Compy. — Arty.
(Signed) —————— Lieut. Colonel.
Commanding Artillery.

FORM No. 35.

Dimensions *of Ordnance in use with the —— Company —— Artillery that require Carriages.*

Nature of ordnance	Marks on the Gun.	Rate of the piece of Ordnance.		When made.	Number.	Length.					Diameter.						Position of the centre of Trunnions.		Bottom of bore.			Weight.			Remarks.
						Of the Piece.		From the centre of the Trunnions to the rear part of the base ring.		From the hind part base ring to the centre of the Elevating screw hole taken in line with the metal.	At the trunnions from Shoulder to Shoulder.		Of the Trunnions.		Of the Bore.		At the axis of the Piece.	Below the axis of the Piece.							
													Right Trunnion.	Left Trunnion.	Taken Vertically.	Taken Horizontally.									
		English.	Bengal.			feet.	ins.	feet.	ins.	inches.	feet.	ins.	ins.	ins.	ins.	ins.		inches.	Hemispherical.	Eliptical.	Flat.	cwt.	qrs.	lbs.	

(Signed)———Captain.
Commanding—— Company—— Artillery.

Station and Date.

(Signed)———Major.
Commanding Artillery.

FORM No. 36.

CONTINGENT BILL.

The Honorable Company ____________________ **Dr.**

To expenses incurred in ____________________

	Rs.	A.	P.
To —— days' pay to one Chuckler for —— —— at ——— per month.............			
„ —— days' pay to one Carpenter for —— —— at ——— per month.............			
„ —— days' pay to one Hammerman for —— at —— per month.....................			
„ —— days' pay to one Bellows Boy for —— at —— per month.....................			
Total Company's Rupees..			
Deduct advance received from the Military Paymaster as per my Receipt dated ———			
Balance due in Company's Rupees...			

Station and Date (Signed) ——————— Captain,
Comdg. —— Compy. — Bn. Arty.

(Signed) ——————— Lieut. Colonel.
Commanding Artillery.

I ——————— Captain, Commanding —— Company —— Battalion Artillery, do hereby declare on my honor, that the charges contained in this Bill are faithful, just, and correct; that the whole sum charged has been actually and bonâ fide disbursed exclusively on account of the Public Service; that the rates charged are the lowest that could be obtained, and that I have not, nor ever shall, either directly or indirectly or in any way or shape whatever, profit by the transaction.

(Signed) ——————— Captain,
Comdg. —— Compy. — Bt. Arty.

Note.—In preparing this Bill, there should be sufficient space left between the signature of the Officer, and the lower line of the Bill, to admit the receipt to be written at full length after the Bill has been sanctioned.

FORM No. 37.

MEMORANDUM *of Articles requiring to be repaired at the Artillery Depôt.*

ARTICLES.	No.	REMARKS.

Saint Thomas' Mount,
— *March* 1844.

——————— Lieut.
Qr. Master 2d Bn. Arty.

——————— Major.
Comdg. 2d Bn. Artillery,

To be written across the above, in red ink, on the completion of the work.

" The Articles mentioned in this Memorandum have been repaired, and are herewith returned."

——————— Major.
Director Artillery Depôt.

Artillery Depôt,
— *March* 1844.

The following to be written on the back.

" Received the within mentioned Articles, the repairs of which have been executed."

——————— Major.
Comdg. 2d Bn. Artillery.

FORM No. 38.

Indent on_________Commissary of Ordnance at______for Package of Arms and Accoutrements, of men sick present, sick absent, and absent on leave.

Number.				Arms and Accoutrements.	Cases Packing	
Sick Present	Wanting to complete	Absent	Total to be carried			
				Muskets with Bayonets		
				Belts Pouch and do		
				Pouches		
				Bayonet Scabbards		
				Packing Materials		

Lieut.
Commanding—Co. 2d Battn.
Major,
Commanding Arty.

FORM No. 39.

Form of Certificate to be written at the foot of the Indent for Package for Arms.

I. A.B. do certify that the number of men, for whose Arms and Accoutrements, Package is Indented for, as sick, are so, and unable to carry their Arms and Accoutrements.

(Signed) A. B. Surgeon,
Battalion.

Note—25 Muskets or 125 sets of Accoutrements to one case—if less than the above proportions are required to be carried, the Ordnance Officer will supply the Package that may appear to be necessary.

FORM No. 40.

Indent on the Superintendent of Stationery Fort St. George.

Sir,—Please to order the delivery of the following Articles of Stationery required for the use of the ________________

on payment for the year ____________

ARTICLES.	Quantity indented for	Quantity sanctioned	Value			Date of Regulation and Authority	REMARKS.

Station
Date

(Signature) of the Indenting Officer

Countersignature of the Commanding Officer.

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THE

COURSE OF INSTRUCTION

IN

LABORATORY WORK,

AND

DIRECTIONS FOR MAKING

PERCUSSION CAPS;

ALSO

AN EXPLANATION OF

THE VARIOUS INSTRUMENTS IN USE

WITH THE

MADRAS ARTILLERY.

COMPILED BY

MAJOR A. F. OAKES,

DIRECTOR ARTILLERY DEPOT OF INSTRUCTION,

Saint Thomas' Mount.

Second Edition, since 1846.

MADRAS:
PRINTED BY REUBEN TWIGG, AT THE CHRISTIAN KNOWLEDGE SOCIETY'S PRESS, VEPERY.
1852.

MEMORANDUM,

With 1st Edition.

The greater part of the contents of this Book, and nearly the whole of the Plates, will be found in the lithographed edition of *Questions and Answers,* which was compiled for the use of the

MADRAS ARTILLERY DEPOT OF INSTRUCTION

In 1825,

BY

MAJOR FRITH,

Of the Madras Artillery,

(Late Lieut. Col. Frith, c. b.)

The instructions connected with the Percussion Cap Manufactory, have been drawn up from Memoranda and letters which had been received from England, and were found among the Records of the Department.

A. F. OAKES, Captain,
Director Artillery Depôt.

Artillery Depot;
St. Thomas' Mount,
January, 1847.

LABORATORY BOOK.

PASTE.

Q. 1. How is paste made?

A. $\frac{2}{4}$ of an ounce of sulphate of copper is dissolved in two quarts of clean water, to which a measure of flour is added, this is poured into a chattie, containing a pint of boiling water; the whole is then well stirred and boiled for about an hour (the addition of the sulphate of copper will prevent insects eating the paste after its application.) If any strong paste be required, an ounce of resin should be added in the first instance.

Q. 2. For what purpose is it used?

A. Paste is used for making up all kinds of paper cases, for rockets, portfires and fireballs, also for finishing rockets, blue lights, &c.

Q. 3. What implements are necessary?

A. A chattie, (fig. 30) and a spatula, (fig. 154.)

CASES.

Q. 4. How are cases rolled?

A. Rocket cases are rolled wet, being pasted all over, with the exception of the first half sheet, which is pasted ⅔ over. Portfire cases are rolled dry, that is, the outer or binding edges only are pasted; in either way the cases are placed under a board, and rolled until they are of the proper gauge.

Portfire.

Q. 5. How are portfire cases rolled?

A. Place an open sheet of portfire paper on the table, with the long side even with the edge of the table, paste the two sides, and one of the end edges, about an inch and a half in breadth; these are termed the three binding edges; double down one third of the sheet upon the former, then turn the former a half turn from you, taking care that the paper adheres to, and turns with the former; then with the rolling board roll from you, continuing to do so until the case is firm, if the case be too large, partly unrol it, cut a slip off and repaste the edge; if too small, add paper to it, and place it again under the rolling board, until it is of the proper gauge: when dry, the case is marked with the date, and name of the person who rolled it.

Q. 6. How are they closed?

A. When partially dry, they are pared down at one end to the extent of ½ an inch with a knife, which is turned in, and a few smart taps given it with the handle of the knife which forms a bottom.

Q. 7. What is the length and diameter of a portfire case?

A. The length is about 18 inches, its exterior diameter [illegible]/16 and interior 4/16 of an inch.

Q. 8. How many cases can a man roll in a day?

A. 120.

Rocket.

Q. 9. How are rocket cases rolled?

A. To roll 1 lb. rocket cases, a sheet of portfire paper is divided at the fold, for ½ lb. rocket cases, it is divided the contrary way; half a sheet of paper is laid down on the table, and pasted about ⅔ over; the former (1·2 inch diameter) is then placed on the dry portion, and one turn of paper is taken round it with the hand; the rolling board is placed on it, and the half sheet of paper rolled up; it is then partly unrolled, and pasted half sheets added until the case is brought up to a gauge, of 1·6 in diameter, the former being moved after each half sheet is added;—it is again partly unrolled, and the last edge of the paper cut in a sloping direction, the base of the sloped part being equal to the exterior circumference of the case; the piece cut off is laid on the last portion of the unrolled part of the case, the case is then rolled up, and the former withdrawn, the quantity of paper required for making one case varies from 2½ to 3 sheets.

Q. 10. How are rocket cases choked?

A. The length gauge is applied to give the position for the choke, the nipple is then placed inside the case in the end of the former, and the choking line or bridle, passed over it which is drawn tight by pressing upon the foot board, care being taken to turn the case upwards and downwards, until the cavity formed by the nipple is filled up; the choke is then secured with a clove hitch of double country twine, and pasted, when the case is dry, the length gauge is applied to mark the bottom of the case, one calibre from the choke, as also the length of the case, viz., 10·45 inches; the bottom of the case is then cut square. The wooden former (1·15 inch in diameter,) used in choking, has a hole bored in the end to admit the nipple, the diameter of the nipple being equal to the diameter of the bottom of the spindle.

Q. 11. How are cylinders made for star rockets?

A. A sheet of portfire paper is equally divided across the fold; one half is then pasted ¾ over, the former (1·5 inch in diameter) is then placed upon the dry portion, one turn of the paper is taken round it with the hand, the rolling board is applied and the paper rolled up; the other ½ sheet, is pasted all over and added; when dry the cylinder thus formed is cut into two, and answers for two rockets.

Q. 12. How are cones for rockets made?

A. A semi circular former of tin (radius 4 inches) is placed upon a half sheet of portfire paper, the figure is marked upon it, and cut out with a pair of scissors. The outer half of the paper is then pasted, keeping the rounded part towards the workman; a wooden conical former diameter of base (1·95, height 3·5) is laid upon the dry surface, and the paper rolled round it, until the cone is completed, taking care to form a perfect point and to make the inside and outside edges meet opposite each other. One sheet will make fourteen cones.

Fire Ball.

Q. 13. In what manner are fire ball cases formed?

A. The former on which the cases are made must be of the diameters given in answer 15, the former is greased all over with tallow, in order that the first coating of paper may not adhere to it, and admit of the former being taken out when required. A sheet of portfire paper is dipped in water then pasted all over and torn into strips of from 1 to 1½ inches in width, according to the size of the case, these are laid upon the former across each other, with the pasted side outwards, until the former is covered; after this, small pieces of paper with the pasted side inwards are added overlapping each other a little, until the case is about ⅒ of an inch in thickness; each case takes from 3 to 6 sheets of paper for the first coat, according to the size of the ball, the case is put out to dry after each coat has been pasted on—the paper is not to be cut, but to be torn asunder.

Q. 14. How is the former taken out of the case, and how is the case closed?

A. When the case is dry it is beaten all round with a wooden mallet to smoothen the surface, and to assist in loosening it from the enclosed former, which is afterwards taken out by cutting the case round the centre into two equal parts, with a knife and mallet, leaving a space of about one inch in length to serve as a hinge; the case is then opened on the side opposite the hinge, and the former removed. The case is closed by pasting the edges, and bringing them together, securing them with slips of pasted paper, the first of which is passed round the joining, other slips are pasted across the first, the case is then dried.

Q. 15. How is the case finished?

A. When dry, four or five coats are put on in small pieces as described in answer 13 which will take from 5 to 6 sheets of paper, when it is again dried; this process is continued until the case is a little beyond the high guage. The case when thoroughly dry and has ceased shrinking, is then finished by being rasped until perfectly round, three holes are bored in it with a brace and bit at the same distance from each other as those in carcases, which are afterwards smoothened and hardened by being burned with a conical red hot iron of the required diameter as laid down in the following table.

Table of Fire Ball Cases.

NATURE.	Weight.				Diameter, &c.			Diameter of Priming Holes.	
	Empty.		Filled.		Of Former.	Of Case.	Thickness of Case.	Exterior.	Interior.
	lbs.	oz.	lbs.	oz.	ins.	ins.	ins.	ins.	ins.
13 Inch.	18	0	38	0	9·6	12.8	1·6	1·85	1·7
0 ,,	7	0	19	0	7·	9·8	1·4	1·6	1·45
18 ,,	4	0	9	8	5·6	7·8	1·1	1·35	1·30
5½ ,,	1	8	3	4	4·04	5·54	·75	·90	·85
4¼ ,,	0	9	1	12	3.2	4·4	·6	·80	·75

Smoke Ball.

Q. 16. How is a smoke ball case formed ?

A. The former upon which the case is formed is greased all over to prevent the paper adhering to it, a sheet of portfire paper is soaked in water, and pasted, it is then torn into strips of 1 or 1½ inch wide, according to the size of the case to be formed, a strip is put round the former with one end covering the other, pasted side outwards ; another slip is added in the contrary direction, leaving four quarters of the former uncovered, slips of the same width are added to each quarter, until the former is covered, small pieces are then added with the pasted side inwards, torn off about 1½ inches in length, the edge of each slip covering that of the one previously laid on, this process is continued until the paper is about 1/10 of an inch thick, which will require from 2 to 5 sheets of paper according to the size of the former ; it is then exposed to the sun until thoroughly dry.

Q. 17. How is the former taken out of the case and how is the case closed ?

A. When dry, the case is beaten all round to smoothen its surface and loosen it from the former, it is then marked round the centre with a lead pencil, and cut in to equal parts by a knife and mallet (the knife being guided on the pencil mark) leaving a space of 1 inch uncut to serve as a hinge. The edges of the two parts are pasted and closed, a slip of pasted paper 1 inch wide is placed round the joining, other slips are pasted across the first and the case placed in the sun to dry.

Q. 18. How is the case finished ?

A. When dry, the case receives from 3 to 5 sheets of paper, which are soaked in water, pasted, torn into narrow strips, and put on in small pieces, care being taken to keep the case as round as possible by dividing the paper equally over its surface ; the case is again put out to dry ; the same process is continued until it is about ·1 of an inch beyond the high guage, it is then left in the sun for a few days to become thoroughly dry, when it will have ceased shrinking ; it is then made round, and to pass through the high gauge by being rasped, one priming hole is bored in with a brace and bit, which is brought to its proper size, and hardened by a conical red hot iron, of the dimension shewn in the following Table.

Table of Smoke Ball Cases.

NATURE.	Weight.				Diameter, &c.			Diameter of Priming Holes.	
	Empty.		Filled.		Of Former.	Of Case.	Thickness of Case.	Exterior.	Interior.
	lbs.	oz.	lbs.	oz.	ins.	ins.	ins.	ins.	ins.
13 Inch,					1·0	12·8	1·40	1·85	1·7
10 ,,					7·5	9·8	1·15	1·6	1·4
8 ,,					6·	7·8	·90	1·35	1·30
5½ ,,					3·94	5·54	·80	·90	·85
4⅖ ,,					3 20	4·40	·60	·85	·80

Q. 19. What articles are necessary for making paper cases?

A. A table, (fig. 163); paste tub (fig. 164); brush (fig. 24); a rolling board (fig. 11); formers, (fig. 60 and 61); pasting rod, (fig. 61); knife, (fig. 88); gauges, (fig. 71, 72, 74, and 75); brace and bit (fig. 20); iron for burning and hardening the holes in fire balls, (fig. 86); bridle, (fig. 21); nipple and former, (fig. 62); conical former, (fig. 57 and 58); rasps, (fig. 131); scissors, (fig. 141); mallet, (fig. 101); compasses Carpenter's, (fig. 172.)

PURIFYING AND PREPARING MATERIALS FOR LABORATORY PURPOSES.

Saltpetre.

Q. 20. In what state is saltpetre required for laboratory purposes?

A. In a refined or purified state for the preparation of laboratory compositions, and is thus supplied from the gunpowder manufactory.

Q. 21. When saltpetre is procured from bazaars, is it necessary to cleanse it previous to preparing compositions of it?

A. When received from bazaars, it is often found dirty and mixed with other substances which must be extracted in the following manner;—weigh the saltpetre, put it into an iron boiler, adding 3 pints of pure water to each pound, and boil it over a moderate fire, skimming away all impurities as they rise,—when the solution has attained such a consistency as to become thick on a piece of cold metal being dipped into it, but without becoming hard when cool, it is poured out into flat metal, or glazed earthen pans to cool.

Q. 22. How is the saltpetre extracted from the water?

A. It will form crystals round the sides and bottom of the pans; the water is then poured off, and the saltpetre exposed to dry, but if not found sufficiently clean, the process can be repeated.

Q. 23. Can the saltpetre be extracted from damaged or unserviceable gunpowder?

A. Yes,—by throwing the gunpowder into clean water, stirring it well up with a spatula, and leaving it to soak some hours,—it should be again well stirred, and repeatedly strained through conical bags of serge, partially filled with clean sand; the water it has passed through is to be boiled and crystallized as in cleaning saltpetre. (Answer 21.)

Q. 24. Why is the saltpetre only extracted from gunpowder, damaged, &c.?

A. It forms a proportion of 75 per cent of gunpowder, therefore the sulphur and charcoal would not compensate for the trouble.

Sulphur.

Q. 25. In what state is sulphur required for laboratory compositions?

A. In the state called flower of sulphur, and is so supplied from the gunpowder manufactory.

Q. 26. If sulphur were received in hard lumps, what process must it undergo to be rendered fit for laboratory purposes?

A. The lumps are broken into small pieces, and placed in an earthen pot or chattie with a round bottom, the bottom of the pot only should be exposed to the fire; the mouth of a second pot is placed on that of the first, and a third over the second, having a small hole in the bottom of it, and the air excluded by prepared clay being well plastered round the mouths of the pots. The upper pot should bulge out as much as possible, and small sticks laid across it to retain the sulphur.

Q. 27. Is there any other method of refining sulphur?

A. Yes,—sulphur of a fair quality may be refined by fusion in a cast iron pot; the lighter impurities float and are skimmed off, the heavier fall to the bottom. When in a state of fusion the sulphur is drawn off by a cock into a conical barrel, and when cool, the hoops are knocked off, and the staves fall asunder leaving a cone of sulphur, the base of which contains all the earthy precipitate, this is separated and laid aside for sublimation.

Charcoal.

Q. 28. How is charcoal for gunpowder and laboratory purposes prepared?

A. It is burnt in an iron cylinder; the cylinder is filled with wood, the dhal gram stalk is considered the best: at one end are two tubes through which the smoke, tar and pyroligneous acid escape—when the gas has ceased to pass out, the charring may be considered complete, the fire is then put out, the tubes closed and the cylinders allowed to cool; care must be taken that the air is not admitted to the charcoal whilst cooling, or it will be impregnated with ashes. Potash is so susceptible of moisture that every care should be taken to preserve charcoal from it.

Q. 29. Is there any other method of preparing charcoal for laboratory purposes?

A. Yes,—charcoal may be made in earthen pots with four small holes in the bottom; after burning, the mouths of the pots are covered with pieces of old wet canvas and a coat of clay to exclude the air; it is allowed to remain in this state 24 hours, when it is taken out and all unburned portions extracted; it is then rolled to a powder, and passed through fine sieves.

Compositions.

Q. 30. What are the necessary precautions in entering composition rooms?

A. Before entering the mixing and mealing-room the men are to be warned that great caution and care is necessary to guard against ignition in an atmosphere filled with particles of the most inflammable nature.

All articles of dress and all implements in which iron forms a part, should be prohibited in the mealing-room, and all hammering or wrenching should be strictly guarded against, when such operations are required, they are to be done in the working-room, or in the open air.

Care must be taken that no particles of iron, sand or stone get mixed with the powder or composition to be mealed, otherwise a serious explosion might take place.

In the hot winds care must be taken to exclude the wind, as it not only blows away the lighter materials, but frequently brings small particles of stone and sand. After mixing compositions, in which antimony forms a part, the boxes should be washed out; and every care taken that no portion, however small, be mixed with those compositions that have to be driven dry, viz., portfire and fuze, as antimony possesses detonating properties, and explodes when driving it.

Q. 31. In making compositions name the ingredients which are, and are not passed through a sieve?

A. The following are passed through a sieve: charcoal, antimony and arsenic.

The following are not: resin, sulphur and saltpetre, the two latter are worked up as received at the Artillery Depôt, from the gunpowder manufactory in a pulverised state.

Q. 32. In what does the strength of the composition depend?

A. In the purity of the ingredients, and in their being well mixed together.

Q. 33. How are laboratory compositions denominated?

A. Under three denominations:—

1st. Dry, or those which only require the simple mixture of ingredients, as in blue lights.

2d. Wet, or those in preparing which, a liquid is used whether as a necessary ingredient, or to give consistency to the dry portions.

3d. Those which require heat to reduce some of the ingredients to a fluid or other proper state, to admit of their mixing with the rest, as in carcasses, &c.

Q. 34. How are dry compositions prepared?

A. The ingredients of all compositions which are to be mixed dry, after being correctly weighed, must be each separately ground or pulverised, and well mixed together by the hand or roller, as will hereafter be described.

Q. 35. How are wet compositions prepared?

A. The ingredients being mealed and correctly weighed in the dry, or measured in the liquid state, are to be mixed well together, by first pouring the liquids together into a proper vessel, and then adding the dry by handfuls, stirring the composition all the time to prevent its forming into lumps.

Q. 36. How are compositions requiring heat prepared, and what should be done if the composition takes fire?

A. If grease be a part of the composition, it is first put into the pot on the fire, to prevent the other ingredients sticking to the sides and bottom, if none is included, a small quantity should still be rubbed over the inside and the bottom of the pot; the other ingredients are to be added by handfuls, care being taken that the masses of the materials to be used are kept at such a distance, that should the portion in the cauldron take fire, the person employed in mixing the composition would be safe: all compositions should be well stirred while melting or mixing.

With these precautions little danger is to be apprehended, though with every care ignition will sometimes occur—when it happens, the lid of the cauldron, which should fit close and always be at hand, must be quickly placed on it to smother the fire, wet gunnies (or powder cloths) must be placed over the lid and cauldron; water is never to be thrown on burning composition.

Q. 37. What are the ingredients for compositions?

A. Antimony,
Arsenic,
Charcoal,
Isinglass,
Mealed Powder,
Oil, Linseed,
Pitch,
Resin,
Saltpetre,
Sulphur,
Spirits of Wine,
Sea Coal,
Tallow,
Thread, Cotton,
Turpentine,
Vinegar,
Wax, Bees.

Fuze.

Q. 38. What are the proportions of fuze composition?

A. Saltpetre lbs. 8¾—Sulphur lbs. 3—Charcoal polls. 9¾, or lbs. ¼.

Q. 39. How is it mixed?

A. The saltpetre is first weighed and rolled 3 hours by itself,—the sulphur is mixed with it and rolled 2 hours—the charcoal is then added, moistened with clean water, well mixed by hand, and rolled about an hour; it is then covered, and after being dried by the sun, is again rolled 2 hours, or until it is reduced to a fine powder.

Q. 40. Does it require more rolling than other compositions?

A. Yes! fuze composition being required to burn to time, it is necessary that the ingredients be thoroughly incorporated.

Q. 41. Do the ingredients bear the same proportion to each other in Fuze as in portfire composition?

A. No; fuze composition being required to burn much more quickly than portfire, contains more charcoal, it therefore follows, that the harder it is driven, its rapidity of burning increases.

Portfire.

Q. 42. What are the proportions of portfire composition?

A. Saltpetre lbs. 11—Sulphur lbs. 3½—Charcoal polls. 3¼, or lbs. ¼.

Q. 43. How is it mixed?

A. The saltpetre having been correctly weighed, is rolled an hour and a half, the sulphur is then mixed with it, and rolled one hour,—the charcoal (having been passed through a fine lawn sieve) is weighed, and added to the saltpetre and sulphur moistened with a little clean water; the whole is then well mixed by hand and passed under the roller for half an hour, it is then placed in the sun to dry, and afterwards rolled until no particle of either ingredient can be separately observed.

Rocket.

Q. 44. What are the proportions of rocket composition?

A. Saltpetre lbs. 4—Sulphur lbs. 1—Charcoal polls. 23, or lbs. 1¾.

Q. 45. How is it mixed, and what time is required it to be rolled?

A. It is mixed exactly in the same manner, and requires to be rolled the same time as Portfire composition.

Blue Light.

Q. 46. What are the proportions for blue light composition?

A. Saltpetre lbs. 9—Sulphur lbs. 2—Antimony polls. 13, or lbs. 1—Arsenic yellow polls. 5, or lbs. ⅜.

Q. 47. How is it mixed?

A. The ingredients are to be correctly weighed, the saltpetre well rolled by itself, the sulphur added mixed by hand with the saltpetre, and passed three or four times under the roller; the antimony and arsenic are pounded separately in a pestle and mortar and passed through a lawn sieve, and then added; the whole to be rolled until thoroughly incorporated.

Carcass.

Q. 48. What are the ingredients and their proportions for carcass composition?

A. Saltpetre lbs. 18¾—Sulphur lbs. 7½—Antimony polls. 24¼, or lbs. 1⅞—Resin polls. 73, or lbs. 5⅝—Venice Turpentine lbs. 1⅞, —and Tallow polls. 24¼, or lbs. 1⅞.

Q. 49. How is it mixed?

A. The saltpetre and sulphur are first well mixed with a roller, the antimony (pounded in a pestle and mortar, and passed through a fine lawn sieve) is then added, and well mixed by the roller: the resin is reduced to a powder in a mixing box, and placed in a pan separate from the other ingredients.

A 5 gallon iron boiler or cauldron is placed on a furnace and all crevices well stopped with clay to prevent the flames rising between them; the tallow is placed in the boiler, and when melted the venice turpentine is added;—when these ingredients have become sufficiently heated, the resin is added by small quantities, taking care to crush by the hand any lumps that may have formed: the saltpetre, sulphur and antimony (blended together in one composition) are gradually added, care being taken to keep the sides of the boiler free from dry particles, by a large knife: the mass to be continually stirred with a wooden spatula until of a proper consistence for pouring into the shell.

Fire Ball.

Q. 50. What are the ingredients and their proportions for fire ball compositions?

A. Saltpetre lbs. 19—Sulphur lbs. 7½—Antimony Polls. 26, or lbs. 2—Resin polls. 73, or lbs. 5⅝—Europe Linseed Oil Quart 1.

Q. 51. How is it mixed?

A. The saltpetre and sulphur are well mixed in a mixing box by a roller, the antimony (pounded in a pestle and mortar, and passed through a fine lawn sieve) is added, and mixed by the roller with the saltpetre and sulphur: the resin is reduced to a powder in a mixing box, and kept in a separate pan.

A 5 gallon cauldron or iron boiler is placed on a furnace so as not to admit fire to rise between them, the interior of the boiler is well rubbed with tallow and the linseed oil poured in; when nearly in a boiling state, the resin is added by handfuls, and kept well stirred with a spatula, when thoroughly dissolved, the saltpetre, sulphur and antimony (mixed together) is brought to the boiler as required in a small copper pan, and added by hand; the composition is to be constantly stirred, and the sides of the boiler kept free from dry composition, until of a consistency to admit of being poured by a ladle into the cases.

Smoke Ball.

Q. 52. What are the proportions for smoke ball composition?

A. Saltpetre lb. 1—Mealed Powder lbs. 5—Sea Coal lbs. 1½—Swedish Pitch lbs. 2—Tallow polls. 6½, or lb. ½.

Q. 53. How is it mixed?

A. The saltpetre is reduced to a fine powder in a mixing box, the mealed powder is added and mixed well by hand; the sea coal (having been pounded in a pestle and mortar and passed through a fine sieve) is added, and the whole well mixed together.

The tallow and pitch are put into an iron boiler and when dissolved, the dry ingredients to be added by hand,—the whole to be kept well stirred till the incorporation is complete when it is put on copper trays to cool.

Rocket Stars.

Q. 54. What are the ingredients and their proportions for rocket stars?

A. Antimony polls. 6½, or lb. ½—Isinglass oz. 1—Mealed Powder oz. 2—Saltpetre lbs. 2—Sulphur oz. 8—Spirits of Wine pint ⅛—Vinegar pint ½.

Q. 55. How is it mixed?

A. The saltpetre, sulphur and antimony are mixed by the roller, the mealed powder is added, and well mixed by hand.

The isinglass is dissolved in the vinegar in a small iron boiler, over a slow fire, the spirits of wine is then added, and when simmering, the dry ingredients are gradually introduced by hand, the composition to be kept stirred with a spatula until thoroughly incorporated.

Q. 56. How are stars formed?

A. The composition being spread on a plate of copper, a cylindrical mould of the required size is pressed upon it, receiving a circular piece of the paste, which is forced out on to another plate of copper dredged with mealed powder; when the latter plate is covered with circular pieces of star paste, taken from the cylindrical mould, each piece is cut into four equal parts, dredged with mealed powder and exposed to the sun to dry.

Valenciennes.

Q. 57. What are the ingredients and their proportions for this composition?

A. Antimony polls. 8, or lb. ⅝—Saltpetre lbs. 6¼—Sulphur lbs. 2½—Resin polls. 16¼, or lbs. 1¼—Oil Linseed, Europe, pint ½.

Q. 58. How is it mixed?

A. The saltpetre is first well rolled, the sulphur is then added, and mixed by the roller, the antimony is to be pounded and passed through a fine lawn sieve, then added to, and mixed with the saltpetre and sulphur.

The resin is reduced to a powder by the roller, and kept in a pan by itself.

An iron boiler is placed over a fire, its inside well greased with tallow, and the linseed oil poured in, when it has become heated, the resin is gradually added; when the resin is thoroughly dissolved the mixed dry ingredients are carefully added by hand, the sides of the boiler to be kept free from dry particles of composition, the whole well stirred with a spatula, until thoroughly incorporated. The boiler is then taken from the fire, and the composition worked with the spatula until cool, and forming a stiff paste.

Dammer.

Q. 59. What is dammer?

A. It is a composition consisting of the following ingredients, viz.

Resin Polls. 90¾, or lbs. 7—Pitch lbs. 2—Wax Bees—Polls. 26, or lbs. 2.

Q. 60. How is it made?

A. The pitch is first melted in an iron pot, the wax is then added, and when all lumps are reduced, the resin, (having been previously rolled) is introduced by hand, and when the froth, which rises on its first boiling has subsided, it is ready for use.

Q. 61. What is it used for?

A. It is used for the protection of the priming and composition of fuzes from the action of the atmosphere; also for securing the capping of carcasses.

Kitt.

Q. 62. What is kitt?

A. A composition resembling Cobbler's wax.

Q. 63. What is it made of and its proportions?

A. Resin Polls. 116¾, or lbs. 9—Pitch lbs. 3; Wax Bees Polls. 39, or lbs. 3—Tallow Polls. 13, or lbs. 1.

Q. 64. How is it made?

A. A chattie is placed upon the fire, into which is put the tallow, this is melted, the bees wax is then cut into small pieces and added, after which the pitch and resin are put in, the whole is stirred incessantly with a spatula, and care must be taken that the composition does not rise over the mouth of the chattie; the capacity of the chattie should be equal to four times the quantity of kitt to be boiled; when thoroughly melted, and mixed, the composition is poured into a bucket of cold water; pieces of it are then taken out and well drawn out by the hands, until the water is worked out of it, it is then closely pressed, or twisted together in convenient pieces, and laid by in a chattie of water for use.

Q. 65. What is it used for?

A. It is used round the fuzes when set in live shells, to fill any cavities that may remain between the fuze and fuze hole, to prevent the flame communicating to the bursting powder in the shell, when the piece is fired.

Q. 66. Is any particular care necessary in preserving and using it?

A. Yes, it must be kept in water, and when required for use drawn out like Cobbler's wax, until soft enough, and care must be taken, that the part to which it is applied is kept perfectly dry, although the hands may be wet.

Q. 67. Name the articles required in mixing compositions?

A. Barrels composition (fig. 6), Box composition (figs. 15 and 19), Box dredging (fig. 16), Box mixing (fig. 19), Brush hand (fig. 22), Bucket water (fig. 25), Chattie (fig. 30), Knives Laboratory (fig. 88), Ladle (fig. 91), Measure Copper 1 Qt. (fig. 104), Mortar and Pestle (fig. 105), Mould Star Rocket (fig. 108), Pans Copper (figs. 114 and 115), Cauldron Iron large and small (fig. 29), Rollers (fig. 135), Scales and Weights (fig. 140), Scrapers (fig. 142), Shovel (fig. 148), Sieves (fig. 149), Spatula (fig. 155), Table mixing (fig. 162), Trays Copper (fig. 167).

Bags Gunny, Bamboo, Lid with staff attached (fig. 96.)

PORTFIRES. (Fig. 124.)

Q. 68. Describe a portfire?

A. It is a cylindrical tube of paper about 16 inches in length, filled with composition.

Q. 69. What is the use of a portfire?

A. To fire the priming of ordnance with rapidity.

Q. 70. In what respect are they objectionable?

A. On account of the strong light they exhibit, serving as a good mark for the enemy's fire especially in the dark.

Q. 71. How are they driven?

A. When the case is perfectly dry and has been properly bottomed, the setter is put into it; the case is then placed in the brass mould, after which the block is screwed up. The setter is withdrawn and the save-all is placed on the mould, so as to fit on the end of the case, a ladle of composition is then put in, and driven down firmly with twenty blows of the mallet, taking care to move the drift at every blow. This is continued until the case is filled, the screws are then loosened, the portfire is taken out of the mould, and the top of the case neatly pared off.

72. *Q*. Are any precautions necessary when driving?

A. Care must be taken that the body be kept perfectly erect to avoid accident in case of explosion; that the ladle contain the same quantity of composition each time, that the same number of blows be given, and with equal force; three drifts of different lengths are used in succession as the composition rises in the case.

A small quantity of composition only should be in each box, not exceeding 2 lbs. during the hot winds this precaution is particularly necessary; the box containing the composition should not be placed on the portfire or fuze block, but on a separate bench, if the box is placed on the block, the saltpetre would at each blow be shaken to the bottom, and the charcoal to the top.

Q. 73. How do you ascertain if it is properly driven?

A. If well driven no impression can be made on the composition when scratched by the finger nail; and when broken, the composition is equally firm throughout as at the end, and it will not crumble.

Q. 74. What would be the effect of a portfire carelessly driven?

A. The parts not receiving the requisite number of blows to each ladle of composition will be softer than the other, and burn much quicker than the paper case: and would probably burst it.

Q. 75. What length of time will a portfire burn?

A. From 14 to 15 minutes, being nearly one inch in a minute.

Q. 76. Should the case burn regularly with the composition?

A. Yes, otherwise a space would be left between the burning composition and the end of the case, which would prevent the fire igniting the priming; when this occurs, the men are obliged to rub the portfire against the ground to break off the case below the fire.

Q. 77. Will a portfire burn under water?

A. Yes, for a short time and no rain should affect it.

Q. 78. How are portfires bundled?

A. In packages of 10, each weighing 3 lbs. having a slip round the centre, and a wrapper at each end, secured with clove hitches of country twine.

Q. 79. Is there any substitute for portfires?

A. Yes, they may be made by boiling rods of parkinsonia, in a solution of nitrate of lead for 6 hours (a quart of water to every pound of nitrate), the rods are then dried and afterwards boiled in spirits of turpentine, wiped and dried, a yard of this match will burn three hours.

Q. 80. What is a drift and its use?

A. A solid steel rod having one end larger than the other to receive the blow of the mallet, the smaller end tipped with brass or copper to prevent the composition taking fire by friction in driving.

Q. 81. Describe a ladle and its use?

A. It is a small copper spoon of a cylindrical form, made to hold a certain quantity of composition, fixed to a wooden handle.

Q. 82. Describe a mallet and its use?

A. An instrument made of wood, for driving composition, varying in weight according to the nature of the work required.

Q. 83. What articles are required in driving portfires?

A.
- Block (fig. 10).
- Composition Box (fig. 15).
- Drifts three (fig. 43).
- Knife (fig. 88).
- Ladle, (fig. 92).
- Mallet (fig. 100).
- Mould Brass (fig. 106).
- Save-all (fig. 136).
- Setter, (fig. 43).

ROCKETS SIGNAL. (Figs. 133 and 134.)

Q. 84. What nature of rockets are made up at the Artillery Depôt?

A. Signal rockets only.

Q. 85. Describe a rocket?

A. It consists of a cylindrical case of paper (answer 9) filled with composition (answer 44) which being tied to a stick and fired, ascends into the air and then bursts. Rockets are used for making and repeating signals.

Q. 86. What articles are necessary in driving them?

	lb.	½ lb.
A. Blockwood to hold mould,	1	1
Boxes (fig. 15),	1	1
Copper pan (fig. 114) and composition,	1	1
Drifts, hollow (fig. 44),	3	2
„ Solid (fig. 44), Scissors (fig. 141),	1	1
Glue pot (fig. 125), Knife (fig. 88),	1	1
Ladle copper (fig. 93), length one and a half diameter, exterior diameter equal to interior diameter of case contains drams.	5	3
Mallet weight (fig. 100),	3½	2
Mould with bottom and spindle (fig. 107),	1	1
Prickers to clean hollow drifts (fig. 127),	1	1
Powder Cloth. Rolling Board (fig. 11),	1	1

Q. 87. How are they driven?

A. The case when dry is driven tightly into the brass mould with the longest hollow drift, the composition is moistened with spirits of wine, and a ladle full put in and driven with 25 blows by a 3½lb. mallet, moving the drift at each blow, and continuing till the composition is ⅓ the height of the spindle, which is indicated by a mark on the drift being level with the top of the mould when it will admit the second hollow drift which is used until the composition is equal to ⅔ the height of the spindle, the third hollow drift is then used until the mark on it is level with the top of the mould, the composition then covers the spindle: the solid drift is applied and one diameter of solid composition is driven on the spindle raising the upper mark to the top of the mould, over this is driven ½ of a diameter of prepared clay, the driving is then complete. Care must be taken when using the hollow drifts, that the hollow part is cleared with a brass pricker after driving each ladle of composition; in driving ½ lb. rockets, two hollow drifts only are used. If the case is too large for the mould, brown soap is rubbed on the outside of the case, if too small, a slip of paper is added, so that the case may fit tightly in the mould; otherwise, the force of driving would burst the interior, and sometimes the whole thickness of the case.

Q. 88. How is the clay for rockets prepared?

A. It is first thoroughly dissolved in water, after remaining at rest a short time, the gravel and sand sink to the bottom, while the clay remains mixed with the water, the latter is poured into shallow pans and evaporated, leaving the clay, which is then dried, pounded and sifted through a fine wire sieve and kept in closed boxes for use.

Q. 89. How are rockets primed?

A. All rockets are primed in the same manner, whether bounce or star, by first taking a small cone, made to fit the choke of the rocket, in which two small holes are made to admit the passing of two ends of a piece of quick match, which being done, the cone with match attached, is secured in the choke with a little paste, a circular piece of dry paper is laid upon the choke end and covered with another piece of pasted paper in the shape of a star; the pointed ends of which are turned down on the case, a pasted slip of paper is then passed round over them, when the priming is completed.

Q. 90. How are they finished?

A. The bounce rocket is finished by first boring a hole through the clay to the composition, and by filling the space above the clay with gun-powder (C. P.) a little mealed powder being previously put in the hole through the clay, a circular piece of paper and pasted star is put over it, in the same manner as in priming, over which is placed a cone, having its edges pasted and fringed this is secured by a slip of pasted cartridge paper.

Star rockets are finished by first cutting off that portion of the case above the clay, then at the height of the composition the case is cut half through, to admit the cylinder of paper to contain the stars, being firmly fixed to it with glue, and a slip of paper pasted round the joining, a hole is bored through the clay to the composition before the cylinder is fixed on the case, the length gauge is then applied, and the cylinder cut to the length required when on the case; a little mealed powder is put in the cylinder to ignite the stars; then the stars, 36 in a 1 lb. rocket, each forming ¼ of a circle, (the diameter of which is equal to the interior diameter of the cylinder) are placed: in the ½ lb. rocket, 22 stars are used, over the top of the cylinder is placed a circular piece of paper with a pasted star, the cone put on, and the rocket is finished in the same manner as the bounce rocket. The length of a star rocket, exclusive of the cone is 12·5 inches.

Q. 91. How is the rocket attached to the stick?

A. On one side at the upper and larger part of the rocket stick or guide, a groove is made equal in length to the height to which the composition is driven, and notches cut on the sides opposite the groove, one corresponding with the choke, the other, one diameter from the end: the rocket is then laid on the groove, and the choke end secured at the lowest notch by a clove hitch of country twine, the upper part of the rocket is then secured in a similar manner in the upper notch; when properly placed the point of balance will be at 25 inches from the point of the cone in the 1 lb. rocket; and in the ½ lb. rocket 22·5 inches from the point.

Q. 92. Does it require any nicety in fixing the sticks to the rockets; and what are the dimensions of the rocket sticks?

A. Yes, as on their being properly fixed, depends the course and flight of the rocket, care is also requisite in selecting the sticks ; they should be made of light dry wood and perfectly straight to ensure an immediate rise, and the proper direction : their dimensions are as follows :

Nature.	Length of Stick.		Breath at the top.	Thickness at the top.	Square at the bottom.
	Feet.	Inches.	Inches.	Inches.	Inches.
1 lb.	8	2	·80	·725	·375
½ lb.	6	6	·70	·50	·250

QUICK-MATCH.

Q. 93. What are the ingredients for Quick-match ?

A. Cotton thread Polls, 3¼, or lbs. ¼ mealed powder lbs. 3, and spirits of wine quarts 3.

Q. 94. What is its use ?

A. Priming rockets, Mortars, Blue Lights, and matching Carcasses Fire balls and Fuzes.

Q. 95. How is it made ?

A. That used for priming rockets, mortars, blue lights, &c. as follows :—A skein of thread is wound into balls of two, three or four threads each ; as many balls as will make the number of threads required for the match, are wound into one. One-eighth of an ounce of isinglass is dissolved in half a pint of water, and added to a portion of mealed powder and spirits of wine, which is put into a copper pan ; the ball of thread is placed in this mixture, and unrolled into another copper pan, care being taken that the thread shall not become entangled in the pan ; mealed powder and spirits of wine should be separately and frequently sprinkled over the contents of the pan ; which are occasionally to be pressed lightly with the hand : when the ball of thread has been unrolled, a small piece of wood is tied to the end of it, the whole of the thread should be completely covered with spirits of wine and mealed powder : the lid is put on and secured with clay to prevent evaporation, after which the thread is left to soak for 48 hours ; it is then reeled upon a frame, passing at the same time through a man's hand, in which is mealed powder and spirits of wine, the quick-match is then thoroughly dredged with mealed powder and put out to dry; afterwards it is made into skeins of 20 strands (or 40 yards) each, by tying them together at the upper side of the frame, and cutting the match on the lower side with a knife: the skeins are tied up and finally put into long boxes which are lined with cartridge paper; one foot should not burn longer than 3 seconds.

Q. 96. What are the lengths of match required for different purposes?

A.				
Fuzes	common,	13	Inch	Two pieces each fuze, each piece 4 inches long.
"	"	10	"	
"	"	8	"	
"	"	5½	"	Two pieces each fuze, each piece 2 inches long.
"	"	4⅖	"	
"	Hand Grenade		"	
"	Sph. Case	8	"	Two pieces each 4 inches, and one 4½ inches long.
"	"	5½	"	Two pieces each 2 inches and one 3¼ inches long.

Priming Mortars.		Length of Match.	
13	Inch	13	Inch
10	"	10	"
8	"	8	"
5½	"	5½	"
4⅖	"	4½	"

Blue light False "	Two pieces each, 4 inches long.
Rocket	One piece 6 inches long.

Q. 97. How is quick-match made that is used for priming carcasses and fire balls?

A. A skein of fine cotton thread is cut into strands of the length and thickness laid down in the following table.

For Carcasses and Fire Balls.	Length.	Thickness.
	Inches.	Threads.
13 Inch 10 "	9	80
8 "	8	80
5½ " 4⅖ "	6	40

A knot is tied at one end of each strand, 20 or 30 strands are then placed in a mixture of spirits of wine and mealed powder and moved about until thoroughly saturated, a second layer of strands is then added, and the mixture increased until the thread is covered by it, this process is continued until the whole of the strands are introduced, care being taken that the last layer of thread is well covered by the other ingredients; the whole is covered by the lid of the pan, which is secured with clay to prevent the evaporation of the spirits of wine, and left to soak 48 hours.

When the match is removed from the pan it is moistened with mealed powder and spirits of wine, laid straight on copper trays, dredged with mealed powder and placed out to dry: when dry it is ready for use.

Q. 98. What implements are required in making it?

A. Two copper pans with lid (fig. 116), box dredging (fig. 16), knife (fig. 88), powder cloth, scraper (fig. 143), sieve (fig. 149), stand with reel (fig. 132), roller (fig. 135)—scissors (fig. 101), trays (fig, 167.)

TUBES PERCUSSION. (Fig. 165.)

Q. 99. For what purpose are percussion tubes used?

A. For the rapid discharge of pieces of ordnance, they are chiefly used on board ships of war, where priming powder is inconvenient, and in rough weather uncertain.

Q. 100. How are percussion tubes ignited?

A. By means of a hammer fixed near the vent field of a gun; the hammer is pulled down with a lanyard by No. 5.

Q. 101. Of what are they composed?

A. One large quill filled with mealed powder, and a smaller one filled with detonating composition.

Q. 102. How are the quills for percussion tubes prepared?

A. The quills are first scraped, and have their feather ends cut off, the large quills have their lower ends cut off, leaving clear barrels of $2\frac{1}{8}$ inches in length, they are then gauged by a diameter gauge of $\frac{3}{16}$ of an inch, the lower ends of the small quills are not cut off, they have clear barrels 1 inch in length and pass through a gauge of $\frac{1}{16}$ of an inch in diameter; in both quills the pith is to be entirely removed from the inside.

Q. 103. How are they filled?

A. The large quills are filled with mealed powder damped with spirits of wine, the larger end of the quill is pressed into the paste and as much of the latter as may be taken up is forced to the lower end by a brass drift, this is continued until the quill is completely filled, the small quills are then filled in the same manner with a composition of chlorate of potass, and antimony in equal proportions, moistened with spirits of wine ; the quills after being filled are pierced with a tapering piercer up the centre of the composition, the small ones two-thirds of their length, the larger ones through their whole length : they are then left to dry.

Q. 104. How are the quills put together ?

A. A hole of sufficient size to admit the small quill is bored in the large one, about half an inch from the top, in a turning lathe: the mealed powder above this hole is removed and the tube is again pierced to ascertain if the vent is clear, in this hole the small quill (having been cut obliquely at the top) is introduced, care being taken that the side which has been obliquely cut is placed downwards, so as to unite the composition in both quills.

Q. 105. How are the quill tubes secured ?

A. Two half hitches and one turn of fine hemp thread rubbed well with bee's wax are put diagonally round the junction of the two quills; the small tube being thus secured, the top of the large one is refilled with mealed powder and spirits of wine; and when dry, the head of the tube to about $\frac{1}{16}$ of an inch below the small one is next dipped in dammer consisting of resin 12 parts, bees' wax 1. When this is dry, the tube is again tubed in varnish composed of gum sandarach ½ an ounce, shell-lac in powder 2 oz. vermilion 1 oz. and spirits of wine, 13 oz. by weight.

Q. 106. How are they packed for service ?

A. In small wooden boxes for land, and in tin boxes for sea service ; each box containing 50 tubes.

Q. 107. What implements are required ?

A. Dammer Cup (fig, 37.)
Drifts (fig. 45.)
Drill Bow (fig 13.)
Drill (fig 47.)
Gauge (fig. 77.)
Glazed Earthenware Cup (fig. 38.)
Hand Lathe (fig. 94.)
Pricker (fig. 128.)
Penknife (fig. 89.)
Round File (fig. 51.)
Small Iron Furnace (fig. 68.)

LIGHTS BLUE.

Q. 108. Describe a blue light?

A. Blue lights are earthen or wooden pans from 5 to 7 inches in diameter, and 1½ to 2 inches deep, filled with a composition, (answer 46,) that gives a brilliant light when burning.

Q. 109. What is their use?

A. For making night signals.

Q. 110. How are they made?

A. The composition (answer 46) being placed in a large copper pan, the cup is taken in one hand, and piled with the other; the composition is filled up in the shape of a cone, and smoothed with a board.

Q. 111. How are they primed and finished?

A. A little mealed powder is dredged over the top, two strands of quick match (answer 96) laid across the point, and a circular piece of country cartridge paper, having its edges fringed and pasted, put over the whole, the ends are folded underneath the cup, over this is pasted a covering of portfire paper, which is also pasted under the cup, when dry the blue light is ready for use.

Q. 112. What precautions are necessary when used?

A. To expose the priming by laying open the paper at the point, and when fired from a gibbet, or other safe place, care must be taken that the burning composition does not fall on any thing which is liable to take fire.

Q. 113. What is their time of burning?

A. From 1 to 2 minutes.

Q. 114. What is their weight?

A. From 1½ to 2½ lbs. when complete; the small ones have 1 lb. the large ones 2 lbs. composition.

Q. 115. Name the implements used in preparing them?

A. Pans Copper, (fig. 114)
Box Dredging, (fig. 16)
Brush, (fig. 24)
Gibbet for burning on, (fig. 78)
Knife, (fig. 88)
Paste Tub, (fig. 164)
Scissors, (fig. 141)
Smoothing Board, (fig. 12)
Table, (fig. 163.)

FUZES. (Fig. 69.)

Q. 116. What is a fuze?

A. A wooden tube decreasing in size from the head downward, with a cylindrical cavity down the centre from the larger end, to within about half an inch from the smaller one; the head (or larger end) is made in the shape of a bowl, and is called the cup.

Q. 117. Of what diameters are the cavities in fuzes?

A. 13, 10 and 8 inch common, and 8 inch spherical case have a cavity of ·4 of an inch, the 5½ and 4⅖ inch common and 5½ inch spherical case ·25 of an inch in diameter.

Q. 118. How are fuzes graduated?

A. When of the proper size and while in the lathe, the exterior is marked in divisions ⅒ of an inch apart; commencing from the bottom of the cup to the end of the cavity, by means of an instrument called a fuze graduator; the circular division at each inch being deeper and broader than the rest, is filled with black wax to show the inches more readily; the fuze is then taken out, the small end placed in a chuck, bored with an auger, and the cup formed with the cup former.

Q. 119. Which material is better adapted for fuzes, wood or metal?

A. Wood, as it can with a rasp, be reduced to any required size; metal is apt to be corroded by the composition.

Q. 120. Of what wood are they made?

A. Generally of Beech; but many have been driven at the Artillery Depôt, made of country woods named Congo, Mookerty, and Cudagooda; consequent on a scarcity of Beech, but these woods have been found not to answer for fuzes.

Q. 121. Why is the bottom of a fuze left solid?

A. That the composition may not be exposed to the atmosphere and that there may be a hard substance to drive against, so as to have the composition of a firm consistency.

Q. 122. What is the use of a fuze?

A. To communicate fire to the powder in shells by means of the composition, with which the cavity in the fuze is filled, and being made to burn to time, the explosion is insured at any desired moment.

Q. 123. How is the composition in the fuze ignited?

A. By means of the flame at the explosion of the charge when the piece is fired.

Q. 124. What is the use of blind fuzes and their composition?

A. For night firing, they consist of

Mealed powder,	ozs.	16½
Wood ashes,	„	9½

and burn about 12 seconds to the inch.

Q. 125. How are fuzes driven?

A. They are first firmly fixed in a block which will contain nine, and a ladle full of composition put into each, the drift is placed in the fuze upon the composition, and the regulated number of blows with a mallet, according to the size of the fuze is given to it, at the same time the drift is turned between the finger and thumb of the left hand: this process is continued until the composition reaches to within 1/10 of an inch from the top of the cavity, when two strands of quick match are placed across in the cup, and secured by 2 blows with the mallet and drift ½ a ladle of composition is then driven over them, which should be sufficiently firm to sustain the weight of the fuze, when suspended by the quick match.

Q. 126. How are the number of blows regulated?

A. For 13, 10 and 8 inch common, and 8 inch S. C. 20 blows to each ladle full.

For 5½ and 4⅖ common, and 5½ S. C.	15	do.	do.	do.
For Hand grenades	12	do.	do.	do.

Q. 127. How is their regularity of burning ensured?

A. By giving the regular number of blows in an uniform manner, and taking care that every ladle of composition contains the same quantity.

Q. 123. Is fuze composition driven wet or dry?

A. Dry.

Q. 129. Why is the drift moved after every blow?

A. To prevent its sticking in the composition, and to lessen the danger of explosion when driving, also to ensure the composition being equally driven.

Q. 130. How do you ascertain when the fuze is properly driven?

A. By scratching the composition with the thumb or finger nail, which if well driven, will receive no impression; neither should it crumble beneath the saw.

Q. 131. How is their burning regulated?

A. All fuzes should burn equal lengths in equal times, and are made to burn one inch in five seconds.

Q. 132. If a fuze cut to burn 15 seconds, is found to burn 17, to what is the defect to be attributed?

A. To the composition not having been driven sufficiently hard.

Q. 133. What is the difference between fuzes for S. C. S. and those for common shells?

A. They differ both in their lengths and priming: S. C. S. fuzes never exceeding 1·4 of an inch in length; common fuzes varying from 2 to 5 inches.

Q. 134. How are fuzes primed and capped?

A. In common fuzes the quick match which is secured in the fuze when driving, is turned down into the cup, which is filled with dry mealed powder; over this a circular piece of portfire paper of the size of a cup is laid, and secured by a larger piece of pasted paper in the shape of a star, which is folded down over the edge of the cup. When dry, the cup is dipped in dammer, (answer 59) as far as the first composition mark.

In S. C. the match is folded down in a similar manner, but the cup is filled with a paste of mealed powder and spirits of wine; over which a piece of quick match is laid, which is drawn across the cup, passing through two of the four cuts which are made in the edge of the cup, previous to driving; the quick match is then passed ¼ round the outside, and again drawn across the other two cuts, on the edge of the cup; the end of the quick match is afterwards broken off, and the fuzes are finished in the same manner as common fuzes.

Q. 135. What is the cause of the difference in their priming?

A. On account of the low angles at which S. C. are thrown and the length of the piece from which they are projected; if the priming in the S. C. fuzes were dry, it would fall out in sending the shell home, which cannot happen with common fuzes as they are always fired at high angles from mortars.

Q. 136. What articles are required in turning fuzes?

A. Chisels, (fig. 31)
Cup former, (fig. 84)
Fuze graduator, (fig. 83)
Gauge, (fig. 73)
Lathe, (fig. 95.)

Q. 137. What articles are necessary in driving fuzes?

A. Composition box, (fig. 15)
Copper ladle, (fig. 90)
Drifts of sizes, (fig. 41)
Fuze Auger, (fig. 82)
Knife, (fig. 88)
Mallet, (fig. 100.)

Q. 138. What articles are required in trying fuzes?

A. Compasses common, (fig. 36)
Fuzes saw, (fig. 137)
Gunter's scale, (fig. 138)
Linstock match, (fig. 97)
Pendulum, (fig. 117.)

Q. 139. What articles are required in capping fuzes?

A. Brush, (fig. 24)
Circular cutters, (fig. 39)
Copper pan, (fig. 115)
Paste tub, (fig. 164)
Cauldron, (fig. 29)
Scissors, (fig. 141)
Smoothing board, (fig. 12)
Star cutters, (fig. 40.)

CARCASSES. (Fig. 26.)

Q. 140. What are Carcasses?

A. Carcasses are shells with 3 fuze holes (13 inch have four); they are projected from mortars, howitzers and guns, and filled with a peculiar composition (see answer 48) which burns with great power and fury from 8 to 12 minutes; the carcass shells do not burst, but the flame rushes out of the holes, firing every thing within its influence.

Q. 141. What is their use?

A. They are much used in bombardments, setting fire to shipping, &c.

Q. 142. How are they filled?

A. The carcass shells, after being well cleaned by scrapers, are placed at a convenient distance from the furnace on a tarpaulin, two of the priming holes in each shell (3 in a 13 inch) are stopped with greased plugs; when the composition is sufficiently mixed (answer 49) it is poured into each shell by a ladle until filled; after standing 21 hours, the composition becomes cool and firm.

Q. 143. How are they primed?

A. When the composition becomes firm the plugs are taken out, and pieces of carcass composition are driven in to fill any cavities that may exist, the whole depth of the priming holes is kept free from composition, a hole is then made in the body of the composition with a brass drift and mallet, into which a strand of quick match of the proper thickness is inserted (its knotted end in the composition) and secured by the mallet and drift; after matching them, the holes are filled within ½ an inch of the top with fuze composition moistened with spirits of wine, which is driven in hard by a mallet and drift, the ends of the match are then folded down, and covered with a paste of mealed powder and spirits of wine, over this is placed a circular piece of portfire paper, which is secured by a circular piece of glued cloth, rather larger than the paper, when it is placed in the sun to dry.

Q. 144. How are carcasses finished?

A. When the cloth coverings are dry, the carcasses are placed on a tarpaulin as close to the furnace as convenient, and when the dammer has become sufficiently heated, the cloth is entirely covered with it by means of a brush, when dry, the edge of the dammer is trimmed round with a knife.

Q. 145. What precautions are necessary when used?

A. The dammered covering must be removed and the ends of the match laid well open and dredged with mealed powder, when loading mortars with carcasses that have no lugs, bearing leathers should be used and care taken, that the carcass does not turn in the bore; and the holes brought upon the charge.

Q. 146. What length of time will they burn?

A. From 8 to 12 minutes.

Q. 147. Can common shells be used as carcasses?

A. Yes, they will produce similar effects, if filled with valenciennes composition (answer 57.)

Q. 148. Is there only one kind of carcass?

A. No, there are two kinds, shell and ribbed; the latter is a frame made of iron hoops covered with canvass and rope yarns, but are only used when others are not procurable.

Q. 149. What is the weight of carcasses empty and filled?
A. As shewn in the following table, viz.

NATURE.	Diameter.	Weight.			
		Empty.		Filled.	
	Inches.	lbs.	oz.	lbs.	oz.
13 Inch	12·84	195	0	224	0
10 „	9·85	90	4	108	8
8 „	7·85	48	0	51	8
5½ „	5·54	15	6	16	9½
4⅖ „	4·44	8	6	8	13

Q. 150. What articles are necessary in filling and priming Carcasses?

A. Brushes, (fig. 22)
Cauldron, (fig. 29)
Drifts wooden, (fig. 46)
Drifts brass, (fig. 173)
Gunnies,
Knives, (fig. 88)
Mallets, (fig. 100)
Ladle Iron, (fig. 91)
Pans Copper, (figs. 114 and 115)
Plugs, (fig. 123)
Spatula, (fig. 155.)

FIRE BALLS.

Q. 151. What are fire balls?
A. They are hollow globes or balls of paper (answer 13) having three holes in them, as in carcasses, they are much lighter than shells as shewn in the following Table.

NATURE.	Diameter.		Weight.			
	Interior.	Exterior.	Empty.		Filled.	
	Inches.	Inches.	lbs.	oz.	lbs.	oz.
13 Inch,	9·60	12·80	18	0	38	0
10 „	7·00	9·80	7	0	19	0
8 „	5·60	7·80	4	0	9	8
5½ „	4·04	5·54	1	8	3	4
4⅖ „	3·20	4·40	0	9	1	12

Q. 152. What is their principal use?
A. For discovering working parties on dark nights, and in In-

dia to set fire to buildings with thatched roofs; but the case being made of paper they cannot be used for this purpose upon terraced or arched roofs.

Q. 153. What articles are used in filling them?

A. Brushes, (figs. 23 and 24)
Cauldron, (fig. 29)
Copper Measures, (fig. 104)
Copper Pans, (figs. 114 and 115.)
Drifts wooden, (fig. 46)
Drifts brass, (do. 173)
Gunnies,
Knives, (fig. 88)
Plugs, (fig. 123)
Scissors, (fig. 141)
Spatula, (fig. 155)
Wooden Mallets, (fig. 100)
Ladles, (fig. 91)
Compasses common, (fig. 36.)

Q. 154. How are fire balls filled?

A. When the composition is sufficiently mixed and fluid (answer 51) the fire balls being placed conveniently for being filled by pouring in the composition while hot, or when cool by putting in pieces with the hand; in the latter case, the composition should be well driven with a 2 ℔. mallet and wooden drifts, previously to the cases being filled, two of the holes are stopped with wooden plugs greased, to prevent the composition adhering to them.

Q. 155. How are the balls primed?

A. When the composition has become cool, (which requires 24 hours) the plugs are taken out, one at a time, and fire ball composition is driven in hard to fill any cavities that may exist, then a hole is made in the body of the composition in each priming hole, into which a thick strand of quick match is inserted and secured; the holes are filled until within a ¼ of an inch of the top with fuze composition damped with spirits of wine, the match is then folded down and covered with mealed powder and spirits of wine made into a paste; over this a circular piece of portfire paper is placed, covered by a circular piece of pasted cloth rather larger than the paper, they are then placed on grummets in the sun to dry.

Q. 156. How are they finished?

A. Europe cartridge paper cut into narrow strips and pasted is carefully put on the ball, leaving the cloth which covers the priming holes bare; when dry they are painted with 2 or 3 coats of red lead ground up with glue water, a circle is described on each priming hole with a pair of gunner's compasses which are painted with lamp black and glue water ; the balls are then marked with the month and year when filled (fig. 4.)

Q. 157. When used, what precautions are necessary ?

A. That the cloth covering be removed, the ends of the match exposed, and dredged as with common shells, and when fired from mortars, bearing leathers to be used to prevent the priming holes turning towards the charge.

Q. 158. What time will they burn ?

A. From 10 to 15 minutes.

SMOKE BALLS.

Q. 159. How are smoke balls filled ?

A. The composition (answer 53) having become cool, it is gradually put into the case, and driven firm by a mallet and drift; when the case is one quarter filled, one proportion of the following dry composition is introduced, a second proportion when half filled, and a third when three quarters filled

Sulphur,..................	1 oz.
Sea Coal,...........	1 oz.

When the last portion of the dry composition has been driven, the case is filled with the former composition.

Q. 160. How are they primed ?

A. A hole is made in the body of the composition, into which a strand of quick-match is inserted and secured, fuze composition moistened with spirits of wine is driven in the priming hole until within ¼ of an inch of the top, the match is folded down and covered with a paste of mealed powder and spirits of wine, over this is placed a circular bit of portfire paper covered by a circular piece of pasted cloth rather larger than the paper, it is then placed in the sun to dry.

Q. 161. How are they finished ?

A. By being covered with narrow strips of Europe cartridge paper pasted, when dry, painted with 2 or 3 coats of lamp black and glue water, the priming hole is afterwards painted with red lead and glue water, and the ball marked with the month and year when made.

Q. 162. For what use are smoke-balls intended ?

A. Smoke balls are fired from mortars, and occasionally from howitzers to suffocate mining parties, or to prevent them continuing their work, also to conceal manœuvres, &c. from an enemy.

VALENCIENNES STARS.

Q. 163. What is the use of Valenciennes Stars?

A. To spread fire from shells when prepared to fire buildings, magazines, &c.

Q. 164. How are they driven?

A. The composition having been properly mixed (answer 58) it is driven with hollow wooden drifts in spindle moulds, each proportion or star receiving 15 blows with the mallet. After each proportion of composition a copper circle (having a hole in the centre to admit the spindle) is put in and a second star driven over it, and so on until the mould is filled, each star being divided by a copper circle.

Q. 165. How are the stars of composition primed and finished?

A. The Stars being thoroughly dry, are wrapped with Europe portfire paper twice round the circumference and pasted down; they are primed with fuze composition and quick-match in the usual way, each ladleful of the charge, receiving the same number of blows as if driving a fuze, they are then painted with red paint, and when dry the top of each is dipped in a composition of mealed powder mixed with spirits of wine.

When the stars are taken out, the mould must be cleaned with oil and oakum, as also the copper circles, previous to being used. If this precaution is omitted the composition is apt to adhere to the mould and is very difficult to be removed.

Q. 166. What implements and materials are required for driving and finishing them?

A. Wooden moulds of sizes with spindles (fig. 110): hollow wooden drifts of sizes (fig. 42); knives (fig. 88); scissors (fig. 141); scales and weights, (fig. 140); copper circles of sizes; mallets (fig. 100); copper pan (fig. 115); fuze composition box (fig. 15).

Q. 167. What weight of prepared composition is put into each nature of shell?

A.				
	13 Inch lbs.	2½	10 Inch lbs.	1⅜
	8 „ „	¾	5½ „ „	3/16
	4⅖ „ „	⅛		

Q. 168. What is the length of each kind of star when driven?

A.

13 Inch	2·5 Inches.
10 „	2· „
8 „	1·5 „
5½ „	1· „
4⅖ „	·75 „

SHELLS COMMON. (Fig. 147.)

Q. 169. What is a shell?

A. A hollow iron ball made sufficiently strong as not to be destroyed by the explosion of the charge of the piece from which it is thrown, with a hole to receive the fuze.

Q. 170. How are shells examined?

A. They are gauged by the H and L gauge, such as pass through the L or low gauge are unserviceable, they are also examined as to their dimensions and weight, the inside is well scraped, and the iron pin at the bottom of the inside driven down or broken off, the rust and dirt being removed by rolling the shell fuze hole downwards, and afterwards giving a few blasts with a pair of bellows; they are then hammered to remove scales and discover flaws; they are to be examined round the sides and at the bottom, to ascertain that they are concentric and of the proper thickness, a file is to be used to try if the metal is soft; and a hammer, to observe if by their ringing tone any fractures are in them; an empty fuze (having the end cut off) is then driven into the fuze hole, and the shell suspended in a tub of water in such manner as to be covered by the latter, care being taken that it does not run into the fuze, in this situation, the mouth of a pair of double blast bellows is inserted in the cup of the fuze, and several strong puffs given; if no bubbles rise in the water, the shell is concluded to be serviceable.

Q. 171. What depth of hole or flaw is sufficient to condemn a shell?

A. Any exceeding ¾ of an inch in large shells.

Q. 172. How are shells prepared for practice?

A. Dry sand equal in weight to the bursting powder is put into the shell, and the fuze is set with a small starting bag, filled with a fixed quantity of gunpowder (answer 172) the starting of which shows whether the fuzes have been correctly or incorrectly cut, and where the shell would have burst had it been prepared as a live shell, viz., with the regulated quantity of bursting powder.

Q. 173. What quantity of powder is allowed for starting fuzes?

A. For the 13 inch shells, 4 oz., 10 inch, 3 oz., 8 inch, 2½ oz. 5½ inch, 1¼ oz., and 4⅖ inch, 1 oz.

Q. 174. How are they prepared for service?

A. The shells have the proper quantity of bursting powder, (answer 174) poured loosely into them through a funnel, and when required to fire buildings, &c. combustible matter is added, such as valenciennes stars, pieces of portfire, carcass and fire ball composition.

Q. 175. What quantity of powder is allowed for bursting shells on service?

A. For the 13 inch, 6 lbs. 12 oz.; 10 inch, 2 lbs. 10 oz.; 8 inch, 1 lb. 14 oz.; 5½ inch, 10 oz.; 4⅖ inch, 5 oz.

Q. 176. On what occasions is it desirable to reduce the quantity of bursting powder for live shells?

A. When they are used at ranges within 600 yards, it is necessary to reduce it by ⅛, to prevent splinters flying into battery and injuring the men.

Q. 177. How are the fuzes prepared?

A. If the fuzes be not graduated, the required length must be taken with a pair of compasses from the line of inches and tenths on the Gunter's scale, and then applied to the fuze, counting from the upper ring under the cup, where the compositions begins; but if the fuzes be graduated (answer 118) the number of divisions according to the number of seconds is counted on the fuze for the length; the fuze must then be carefully sawn straight across, tried in the fuze hole of the shell, and if too large, rounded off with a fuze rasp; if too small, a little fine oakum should be wrapped round them, or they should be reserved for shells having smaller fuze holes.

Q. 178. How are fuzes set?

A. A fuze thus prepared is then placed in the fuze hole, the setter (with a little oakum in its cavity) is placed on the fuze, and several smart blows given it with the driver, the setter being moved after each blow; not more than the cup should be left above the surface of the shell, as the greater the length of fuze above it, the more exposed it will be to the action of the air, and render the shell more liable to deviate from its direction, and the fuze to injury in passing from the piece ; this is of less consequence with mortars than with howitzers and guns.

Q. 179. What is the next operation after setting the fuze ?

A. After the fuze is fixed a little kitt (answer 63) should be placed round it to fill up any crevices that may exist between the fuze and metal of the shell, and so guard against accidents, the range is afterwards marked on the shells with chalk or paint.

Q. 180. What are the diameters and weights of the common shells ?

A. They are as follows :

NATURE.	Thickness.	DIAMETER.				WEIGHT.			
		Max.	Min.	Fuzeholes		Empty.		Filled.	
				Exterior.	Interior.				
	ins.	ins.	ins.	ins.	ins.	lbs.	oz.	lbs.	oz.
13 Inch..................	·2	12·88	12 80	1·85	1·7	196	0	203	0
10 ,, ...	1·6	9·88	9·80	1·6	1·5	87	0	90	0
8 ,, ...	1·3	7·95	7·85	1·2	1·1	44	0	46	0
5½ ,, ...	8·5	5·639	5·584	·78	·8	15	0	16	0
4⅖ ,, ...	·7	4·476	4·432	·77	·7	7	8	8	0

Q. 181. What implements are necessary for examining shells and preparing fuzes ?

A. Bellows, (fig. 8).
Bucket, (fig. 25).
Compasses, Common, (fig. 36).
Compasses Calibre, (figs. 33 and 34).
Driver, (fig. 49).
Gauge, (fig. 76).
Gunter's Scale, (fig. 138).
Hammmer, (fig. 80).
Hooks, Cant, (fig. 81).
Rasp, (fig. 131).
Saw, (fig. 137).
Scraper, (fig. 142).
Setter, (fig. 49).
Table, (fig. 163).
Vice, Bench, (fig. 168).

Q. 182. Why are common shells cast thicker than the shells for spherical case shot ?

A. Shells are required to penetrate the roofs of buildings, magazines, &c. which object could not be effected with shells of less weight.

Q. 183. When using common shells from 24 and 12 Pdr. Howitzers, what fuzes are used?
A. 5½ inch spherical case.

SPHERICAL CASE SHOT. (Fig. 152).

Q. 184. What do you call spherical case shot?
A. They differ from common shells by being thinner, and filled with musket balls, with a small charge of powder (answer 189), it is made to explode at any required distance, by means of a fuze (answer 122) in the same manner as a common shell, when the small leaden balls and the splinters of the shell proceed and complete the curve in which the shell was proceeding at the time of its explosion; the old spherical case shell has a neck projecting inwards from the fuze hole, to ensure the fuze being securely set, those now sent from England have an increase in thickness of metal immediately round the fuze holes, answering the purpose of the neck in the old shot.

Q. 185. How are they examined?
A. In the same manner as common shells (answer 169).

Q. 186. How are spherical case prepared for service?
A. After being examined and found serviceable, they are filled with leaden balls; when about half filled, a stick of strong hard wood from 10 to 15 inches long, turned so as nearly to fill the fuze hole, is applied to pack them tight, putting in a few balls and the stick alternately, until the shell is well filled; care being taken that the fuze hole is kept clear. The bursting powder is then poured through a funnel into the shell, shaking it until the powder is all admitted.

Q. 187. How are S. C. fuzes prepared?
A. They are always cut one inch in length, unless more composition is required; when less than one inch is wanted, the scale of the fuze auger is set to the number of tenths required, and the surplus composition bored out. As the auger may get

shorter by use, the surest method of setting it, is, by placing the end of the auger or bit against the edge of a table, the felloe of a wheel or any other level surface, holding, the brace in the left hand with its bend upwards; the slide with scale attached is then pushed against the table, and secured with the screw; the index on the lower slide is placed at figure 10, and made fast, the upper slide is then placed at any number of tenths required; say, if for 6 tenths, the scale is pushed down until the bevelled edge of the index cuts the figure 6, and is made fast; there will then be 4 tenths of the auger, above the upper slide.

In boring out the composition, care must be taken (particularly if only 2 or 3 tenths of fuze are required) that the fuze auger is not pressed so hard as to displace the composition to be left in the fuze.

Q. 188. How are spherical case fuzes set?

A. The fuze having been prepared in the manner described in the preceding answer, 2 strands of quick-match, each 2 inches long, are placed in the fuze hole of the shot, the fuze is then firmly set with a driver and setter, leaving only the cup of the fuze above the surface of the shell.

Q. 189. Are there any precautions necessary in setting fuzes?

A. Yes,—that a little oakum is placed in the cavity of the setter, and that the setter be moved after each blow, to prevent the cup of the fuze from being split.

Q. 190. What is the regulated number of musket balls, and quantity of bursting powder for spherical case?

A. For the	8 Inch	377	Balls.	15 oz.	Powder.
„	32 Pdr.	176	„	7	„
„	24 „	130	„	6	„
„	18 „	90	„	5	„
„	12 „	63	„	4½	„
„	9 „	41	„	3½	„
„	6 „	27	„	2½	„
„	3 „	11	„	1¼	„

Q. 191. What are the weights and thickness of spherical case shot?

A. They are as shown in the following table.

Nature.	Thickness.	Weight.			
		Empty.		Filled.	
	Ins.	lbs.	oz.	lbs.	oz.
8 Inch	·9	31	6	58	0
32 Pdr	·0	0	0	0	0
24 ,,	·6	11	0	20	0
18 ,,	·5	8	4	11	12
12 ,,	·45	5	12	10	2
9 ,,	·4	4	8	8	12
6 ,,	·3	3	0	5	0
3 ,,	·0	1	8	2	4

Q. 192. What is the use and effect of spherical case shot?

A. They are generally used against bodies of Cavalry and Infantry with the same effect as canister, but at much longer ranges.

Q. 193. What articles are required for preparing spherical case shot?

A. Augur Fuze, (fig. 2).
Basket Rattan, (fig. 7).
Bellow's Laby. (fig. 8).
Bucket, (fig. 25).
Fuze Table, (fig. 161).
Guages, (fig. 76).
Packing Stick, (fig. 160).
Saw (fig. 137).
Compasses Calibre, (figs. 34, 35).
Driver and Setter, (fig. 49).
Funnel, (fig. 65).
Scraper, (fig. 142).
Vice Bench, (fig. 168).
Vice Wooden Fuze, (fig. 170).

CANISTER SHOT.

Q. 194. Of what is the case for canister shot made?

A. It is made of tin, and is equal to the diameter of round shot.

Q. 195. How is the case made?

A. The tin is cut by a pair of shears to the length required, (see table) and beat round by a wooden mallet on a former of the proper diameter, the edges are then turned over to form a lapping joint, which is beaten together by a wooden mallet and soldered; one end of the case is then turned in to about one-tenth of an inch in depth, the top (a circular piece of tin with two holes cut in it, in which is fixed a loop of log line,) is introduced, and securely soldered to the edge turned inward.

Q. 196. How are the bottoms prepared?

A. That part of the bottom which is of wood is prepared by a turner, of the size laid down in the following table; the iron plates are prepared by smiths, of the required size, then countersunk in the wooden bottom, and secured by an iron bolt passed through them and rivetted.

Q. 197. How is the case filled?

A. A layer of oakum is placed inside the case on the top, the regulated number of iron balls of the required size are then introduced, the case is shaken that the balls may pack closely; a layer of oakum is put upon the balls, and the bottom placed in, which is gradually forced into the case to the required depth by a screw-press, when it is made secure by a few tacks being driven into it through the case.

Q. 198. What are the dimensions and weight of materials for canister?

A. As shown in the following table:—

NATURE.	BALLS.		CASE.					WOODEN BOTTOM.				IRON PLATE.				IRON BOLT.				Total weight of Shot.		
	In each Case.	Weight of each.	Length.	Diameter.	Weight.			Thickness.	Weight.			Thickness.	Weight.			Length.	Diameter.	Weight.				
	No.	Ounces.	Inches.	Inches.	lbs.	Ounces.	Drams.	Inches.	lbs.	Ounces.	Drams.	Inches.	lbs.	Ounces.	Drams.	Inches.	Inches.	Ounces.	Drams.	lbs.	Ounces.	Drams.
56 Pdr. Ir. Gun,	39	16	8· 5	7·55	1	7	0	5·	4	12	0	¼ Inch sheet Iron is generally used.	1	4	0	5·	·3	1	14	48	0	0
56 ,, ...	78	8	8· 5	7·55	1	7	0	5·	4	12	0		1	4	0	5·	·3	1	14	48	0	0
8 Inch, ...	45	16	8·	7·95	1	5	0	5·	5	6	8		1	7	0	5·	·3	1	14	53	0	0
8 ,, ...	90	8	8·	7·95	1	5	0	5·	5	6	8		1	7	0	5·	·3	1	14	53	0	0
32 Pounder, ...	132	4	10·	6·207	1	5	11	2·	1	8	8		0	13	10	2·	·3	0	8	35	8	0
24 ,, ...	92	4	9·	5·639	1	0	12	2·	1	6	0		0	11	6	2·	·3	0	8	25	8	0
18 ,, ...	78	4	8·75	5·124	0	15	0	2·	1	4	0		0	8	0	2·	·3	0	8	21	10	0
12 ,, ...	50	4	7·25	4·476	0	10	10	2·	0	12	12		0	5	12	2·	·3	0	8	14	0	0
9 ,, Gun,	40	4	6· 4	4·1	0	8	4	1·2	0	6	6		0	4	8	1·2	·25	0	4	11	0	0
6 ,, ,,	25	4	5.75	3·568	0	6	0	1·2	0	3	14		0	3	8	1·2	·25	0	4	7	0	0
3 ,, ,,	12	4	4· 5	2·833	0	3	12	1·	0	2	3		0	1	6	1·	·25	0	3	3	6	0
10 In. Ir. Howr.	160	8	9· 5	9·88	2	5	8	6·	9	14	12		2	6	0	6·	·3	1	14	102	12	0
8 ,, ...	188	4	8·	7·95	1	5	0	5·	5	6	8		1	7	0	5·	·3	1	14	54	3	0
24 Pdr. Brass, ..	60	4	5·	5·584	0	10	0	1·8	1	0	0		0	11	6	1·8	·25	0	6	16	14	0
12 ,, ...	37	4	5·	4·432	0	7	8	1·8	0	10	8		0	6	8	1·8	·25	0	6	10	8	0

Q. 199. Does Canister for sea service differ from that for land service ?

A. Yes,—Canister made for the 56 Pdrs. and 8 inch guns for sea service contain 16 oz., and for land service, 8 oz. balls.

Q. 200. Do the bottoms of Canister for howitzers differ from those for guns ?

A. Yes,—those for 10 and 8 inch howitzers are ·65, and for 24 and 12 Pdrs. 1 inch less in diameter at one end than at the other, which is not requisite in Canister shot for ordnance without chambers.

Q. 201. How much of the bottom is inserted in the case ?

A. In Canister for 10 and 8 inch howitzers 1 inch only, for 24 and 12 Pdrs. 1·15 inches, and for guns half the thickness is inserted.

Q. 202. How is Canister shot finished ?

A. The case and top receive two coats of red lead ground with glue water, when dry, the bottom is painted black with lamp black and glue water, and the Canister placed again in the sun to dry ; after the bottom has become dry, the case is marked with black paint, with the calibre of the piece it is intended for, the number and size of iron balls, its total weight, and the month and year in which made, they are then gauged in the usual manner.

Q. 203. If Canister shot are not procurable, what are good substitutes ?

A. On a former, from ½ to ¾ of an inch less in diameter than the shot, roll a case of portfire paper, until its exterior diameter, is equal to that of the shot ; and its length 2 diameters and 3 inches, fit in a wooden bottom 2 inches thick securing it with tacks, and when dry, fill the case with musket or other balls, fitting a top of 1 inch thick over them, which is also secured with tacks, or a bamboo equal in diameter, with the shot so cut, that one end may be closed with one of its joints, and filled with balls putting in a wooden bottom of 1½ or 2 inches thick, over them, and securing it with tacks.

Q. 204. What articles are used in making Canister shot ?

A. Formers Wooden, (fig. 175.)
Mallet, (fig. 101.)
Press, (fig. 126.)
Shears, (fig. 146.)
Hammer Claw, (fig. 176.)
Gauges Shot, (fig. 76.)
Beak Iron, (fig. 85.)

CARTRIDGES SMALL ARMS.

Q. 205. Of what paper are ball cartridges made ?

A. They are made of Europe whited brown.

Q. 206. How many ball cartridges will a sheet of Europe cartridge paper make ?

A. Each sheet of paper measures 22 inches by 17 and will cut 16 papers for percussion, musket or fuzil ball cartridges.

Q. 207. How are cases for musket and fuzil ball cartridges made ?

A. A sheet of paper folded is laid upon the table, the folded edge is doubled over 1 inch and cut off, which gives a slip 2 inches wide ; the paper is then folded bringing the ends even, it is again folded bringing the outer edges together, leaving the sheet formed into eight equal parts, two opposite corners are then brought together which gives 16 papers.

Q. 208. How are ball cartridges made ?

A. In making ball cartridges the former is laid on the paper, the hollow end next the longest side but 1 inch from it ; one turn is taken round the former with the paper, its hollow end is then covered with the paper, upon which place the ball : it is then rolled up and kept tight, taken up by the left hand, and the ball secured by a clove hitch of Europe twine : the paper below the hitch is trimmed with a pair of laboratory scissors but not too close ; a tap is then given it with a mallet to spread the tufted end of the paper and secure the hitch : the case is then ready for filling.

Q. 209. How are the cases filled ?

A. They are placed upright on their closed ends in a box, a copper funnel is held in the mouth of the case, and the powder poured into them by a small copper measure made to hold exactly the quantity required, by this method cartridges are filled with great expedition and correctness as to quantity.

Q. 210. How are ball cartridges folded ?

A. Previous to folding, the ends of the box containing the cartridges should alternately be allowed to fall two or three times on the table that the powder may pack closely, a cartridge is then taken from the box between the forefinger and thumb of the right hand, the paper above the powder is made flat and brought to form a right angle with that part containing the powder, it is then folded on each side, one fold covering the other and turned down close to the cartridge, the folds being undermost.

Q. 211. How are Ball Cartridges bundled?

A. Two forms of paper are requisite, viz., the wrapper and the slip, 3 cartridges are laid in the left hand, placing the ball of one cartridge opposite the folded end of another; 4 more are laid upon these, then 3 more on them, placing the balls alternately as in the first 3; one end of the slip is laid between the left thumb and the cartridges, and then folded round the whole, and secured by country twine passed twice round at each end immediately under the balls and tied with a reef knot, the bundle is then placed on the wrapper which is neatly folded round it and secured with country twine passing over each end, crossed in the centre and tied with a reef knot on the side, the wrapper is stamped with the nature of the cartridges, the charge, and nature and year of manufacture of powder.

Q. 212. How many wrappers, or slips will a sheet of paper make?

A. One sheet of paper will cut—

Wrappers, Musket or Fuzil, - - -	8
Slips, ,, ,, ,, - - -	12

the slips cut off in making cartridges, are to be used in bundling.

Q. 213. How are balls cast?

A. The lead is put into an iron pot, with half a measure of cocoanut oil per 100 ℔s., and when melted, if any scum should appear, it is taken off with an iron dipping ladle, the lead should not be made too hot, but sufficiently fluid to run freely, otherwise the balls will not be cast solid : the metal is taken out with a ladle and poured into a mould where it remains about half a minute, the balls are then taken out and the gules or projecting part cut off with a cutting instrument.

Q. 214. What are the weights of balls for small arms?

A. For Percussion Musket or Fuzil,	14½	weigh	1 ℔.
,, Rifle, - -	12½	,,	1 ,,
,, Pistol and Carbine,	14½	,,	1 ,,

1624 Musket balls weigh 1 cwt.

Q. 215. How are ball cartridges packed for Field service?

A. In boxes containing 850 musket each, in the Field they are slung over Bullocks the same as powder barrels; the boxes are covered with wax cloth and gunny, and marked with the nature and number of rounds of ammunition.

Q. 216. How are they packed for dispatch by sea ?

A. Each bundle of cartridges is wrapped in wax cloth, secured by country twine, and packed in ammunition boxes and barrels ; the barrels and boxes are then covered with wax cloth and gunny and painted with the nature and number of rounds in each. Barrels with copper linings should be used for packing ammunition for dispatch by sea, if available.

Q. 217. What are the charges for Ball cartridges ?

A.

Nature.		Percussion.	Flint Lock.
Musket,	Drams	4⅓	6
Fuzil,	,,	4⅓	5
Carbine and Pistol,	,,	2½	3
Rifle,	,,	2½	0

Q. 218. Of what paper are blank cartridges made ?

A. They are made of country blue, in order to avoid mistakes in serving out ammunition.

Q. 219. How many blank cartridges will a sheet of country paper make ?

A. Each sheet measures 19 × 13 inches, and will cut into 16 papers for Percussion Musket or fuzil blank cartridges ?

Q. 220. How is the case made for Percussion Musket or Fuzil blank cartridges ?

A. Open a sheet of paper and cut off a slip 13 inches by 1¼ from one end of the sheet, fold the 17¾. inch side into 4 equal parts, then bring the 2 ends together ; and join two opposite corners, will give 16 papers.

Q. 221. How are blank cartridges made ?

A. The former is laid upon the paper with its hollow end next the longest side and ¾ of an inch from the edge, one turn is taken round the former with the paper, and one thickness of it turned over the end of the former; it is then rolled up and the projecting part turned in on the former at 4 different times the last turn of the paper having a twist given it: this end is placed upon the table and a few smart taps given to the former by a mallet, the former is then slightly withdrawn and the bottom of the case gently pressed by the thumb into the hollow end, and the former taken out.

Q. 222. How are blank cartridges filled?

A. They are placed upright in a box and the powder poured in them by a copper measure made to contain the regulated charge.

Q. 223. How are they folded?

A. Exactly in the same manner as ball cartridges, (see answer 209).

Q. 224. How are they bundled?

A. In the same manner as ball cartridges, except that slips only are used secured by a strand of country twine twice round the centre tied by a reef-knot; blank cartridges are generally made up by corps.

Q. 225. What is the charge for blank cartridges?

A. It is 3½ drams for all small arms.

Q. 226. What articles are required in preparing ball and blank cartridges?

A. Barrel ammunition (fig. 5); Box ammunition (fig. 14); Box for filling (fig. 17); Former (fig. 56); Knife (fig. 88); Measure for filling (fig. 174) Mallet (fig. 99); Scissors (fig. 141); Table (fig. 163); Funnel (fig. 65).

CARTRIDGES, ORDNANCE.

Q. 227. How are ordnance cartridges made?

A. They are so cut as to fit the bore of the gun or the chamber of the howitzer, their shape is given by a flat wooden former, 1½ the diameter of the bore or chamber; the end that forms the bottom of the cartridge, is divided into two points by which the bottom is in four parts, and when sewn together forms a hemispherical bottom.

In making them, the serge or cloth is doubled, and the former placed on it, the cartridge is marked with charcoal, or lamp black round the former, ¼ of an inch being allowed for sewing, which is done with worsted thread, the stitches to be close, and regular; they are then turned and are ready for filling.

Q. 228. What are cartridges for garrison and field ordnance made of?

A. Serge, either white, or coloured.

Q. 229. Which is considered the better?

A. The coloured, it being closer in texture, and not so liable to be destroyed by insects.

Q. 230. How are they filled?

A. The charge being weighed, is put into the bag through a funnel, the loose end of the bag is then grasped by the left hand, and several smart blows given with the edge of the right hand all round the bag, to settle the powder; the bag is then tied with a double hitch of country twine.

Q. 231. What articles are required in making them?

A.	
Formers, (figs. 54 and 55.)	Scales and Weights, (fig. 140.)
Funnel, (fig. 67.)	Scissors, (fig. 141.)
Measures, (fig. 103.)	Thimbles, (fig. 166.)
Needles, (fig. 112.)	

Q. 232. What quantity of powder is used in filling cartridges for iron guns?

A. The quantities shown in the following Table, viz.:—

NATURE OF ORDNANCE.	Service Charge.		Proof 600 yards.		Proof 700 yards.		Hot Shot.		Proof of Ordnance.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
42 Pdr.	14	0	11	10 11/16	11	3¼	9	0	25	0
32 „	10	10⅔	8	14 3/16	8	8 7/16	6	6⅜	21	8
24 „	8	0	6	11	6	7	4	12¾	18	0
18 „	6	0	5	0	4	13	3	9 9/16	15	0
12 „	4	0	3	6	3	4	2	6⅜	12	0

N. B.—At 600 yards proof ⅙ is deducted, and at 700 yards ⅕.— For hot shot the charge is ⅕ the weight of shot.

Q. 233. What quantity of power is used in filling cartridges for brass and iron howitzers and brass guns?

A. As shewn in the following table.

NATURE OF ORDNANCE.	Service Charges.	
	lbs.	oz.
10 Inch Iron Howitzer, ...	7	0
8 ,, ,, ,, ...	4	0
24 Pdr. Brass ,, ...	2	0
12 ,, ,, ,, ...	1	4
4⅖ ,, ,, ,, ...	0	8
9 ,, ,, Gun	2	4
6 ,, ,, ,, ...	1	8
3 ,, ,, ,, ...	0	12

N. B.—The charges for howitzers are fixed, those for guns are equal to ¼ the weight of the shot.

Q. 234. What are the dimensions of formers, and quantity of serge and cloth required in making cartridges ?

A. As in the annexed Table, viz :—

NATURE OF ORDNANCE	FORMERS.					100 EACH.	
	Total.		Fork.				
	Length.	Breadth.	Height of	Breadth at bottom of	Breadth at top of	If of Serge colored 1 yard wide.	If of Vizagapatam Cloth.
	Ins.	Ins.	Ins.	Ins.	Ins.	Yards.	Yards.
42 Pdr. Iron Gun.....	23·5	10·3	3·7	9·8	5·1	0	0
32 ,, ,, ,, ...	22·6	9·1	3·	9·1	4·5	36	36
24 ,, ,, ,, ...	21·	8·3	2·8	8·3	4·2	26⅛	26
18 ,, ,, ,, ...	19·7	7·45	2·5	7·45	3·9	25	24
12 ,, ,, ,, ...	16·7	6·4	2·25	6·4	3·5	21	22
9 ,, Brass ,, ...	11·5	6·	2·	6·	3·1	12⅙	16
6 ,, ,, ,, ...	9·	5·4	1·75	5·4	2·65	9⅛	14
3 ,, ,, ,, ...	7·9	4·	1·25	4·	2·	6⅓	0
10 Inch Iron Howr. ..	16·65	15·	4·	10·5	4·9	38	0
8 ,, ,, ,, ...	13·3	11·8	3·6	9·1	4·2	23	0
24 Pdr. Brass ,, ...	9·	8·4	2·	6·	2·7	13⅕	0
12 ,, ,, ,, ...	8·	6·6	1·5	4·8	2·4	11⅛	.0
4⅖ Inch ,, ,, ...	8·	4·1	1·3	3·4	1·8	0	0

Q. 235. How are ordnance cartridges carried ?

A. For light field guns, they are always carried filled; with heavy field ordnance they are carried empty and filled as required.

BAGS.

Bursting.

Q. 236. What are bursting bags, and of what are they made?

A. They are small bags or cartridges, made of Vizagapatam white cloth, in which are put the charges of powder, for bursting common shells, or S. C. shot; the quantities required for different shells are laid down in answers 175 and 190.

Q. 237. How are they carried?

A. In the copper boxes of light field carriages; and when required to load the shells, the powder is poured from them through a funnel, the empty bags being returned to the limber.

Q. 238. What articles are required in making them?

A.	Former, (fig. 52.)	Scissors, (fig. 141.)
	Needle, (fig. 112.)	Thimble, (fig. 166.)

Starting.

Q. 239. What are starting bags made of?

A. They are made of common white cloth, and hold a small charge of powder, for starting the fuze of a shell.

Q. 240. What is their use?

A. To show where the shell would have burst, had the proper charge of powder been inserted, also whether the fuze burns correctly.

Q. 241. When, and how are they used?

A. They are only used at mortar and howitzer practice; the bag with its charge is put into the fuze hole of the shell, and the fuze set tight within it; the powder is ignited by the flame from the composition when it has burned through the fuze.

Q. 242. What articles are necessary in making them?

A.	Former, (fig. 52.)	Scissors, (fig. 141.)
	Needle, (fig. 112.)	Thimble, (fig. 166.)

COTTON, OR SLOW MATCH.

Q. 243. What is cotton match?

A. It is made of coarse cotton thread, twisted into a rope, one-tenth less in diameter than the tube of the new pattern linstock, but not so hard as other kinds of cotton rope.

Q. 244. How many yards are in a skein ?

A. From 15 to 20, weighing from 3½ to 5 lbs.

Q. 245. What is necessary in preparing it ?

A. The only preparation necessary, is, sewing the strands together, to prevent them spreading, by the explosion of the charge when the piece is fired.

Q. 246. What is its use ?

A. To keep a light, in order to be prepared to fire at all times, and is used occasionally to fire the priming of guns instead of portfires.

Q. 247. What is its rate of burning ?

A. One foot of it will burn about 2 hours.

Q. 248. How is it carried with light field guns ?

A. A portion of match is carried in the match box on the left side of gun carriages, and on service, is always kept burning, for the purpose of lighting portfires.

The match box is divided in the centre, one half being lined with copper having a hole in it ; in this hole the lighted end of the match is kept, and the skein neatly folded within.

Q. 249. How is it carried with the heavy guns ?

A. About 2 yards are attached to a linstock, one end being passed through the tube with 6 or 7 inches hanging clear, the other end is twisted round the stock and made fast with a piece of twine. It is generally used for firing heavy guns.

Q. 250. What articles are required to prepare it ?

A. Needles, (fig. 112.) Scissors, (fig. 141.)
Thimbles, (fig. 166.)

COLLARS, AND GRUMMETS, FOR SHELLS AND SHOT.

Q. 251. How are shot and shells prevented turning in the bores of pieces of ordnance while loading ?

A. By fixing to them collars, or grummets ; the latter being used with guns, and the former with brass howitzers.

Q. 252. Is there any other benefit derived from the use of collars and grummets ?

A. Yes,—they ensure the fuzes of shells and spherical case shot, being kept in the centre of the bore and always towards the muzzle, and with howitzers one half of the shell is admitted in the chamber close to the cartridge.

Q. 253. Of what are collars made, and what are their general dimensions ?

A. They are made of double tin, and for the convenience of removing the shells from the ammunition boxes, a handle of log line is fixed to the circular top ; the diameter of the collar is equal to that of the low gauge and its depth to one-fourth of its diameter.

Q. 254. How are collars made ?

A. The collar itself is first formed by a tinman from a strip of tin of the proper width and length, by joining its two ends together with an overlapping joint, one edge is then turned inwards forming a flange ·15 of an inch in breadth, under this flange is soldered the circular top, having previously had two holes cut in to receive the handle of log line.

Q. 255. How are the collars fixed to shells ?

A. Two openings are made in the top of the collar, by clipping the opposite inner edges and turning up the tin. The collar is then pressed closely down on the shell to prevent the escape of the composition, which is poured through the openings, until the space between the collar and shell is completely filled ; the shell is then put away until the composition is cold when the openings are closed by pressing down the two pieces of tin to their original position.

Q. 256. What is the composition made of, and how is it prepared ?

A. Glue and resin in equal parts. The glue is first dissolved in water and then placed in a pan over a fire ; the resin, reduced to fine powder, is added by small quantities at a time ; no more water is used, than may be sufficient to keep the composition from burning. It is applied while hot.

Q. 257. What is a grummet made of ?

A. Of Europe rope, formed into a circle ; the outer diameter being equal to the low gauge for guns, and for the iron howitzer 10 and 8 inch, equal to the high gauge of 68 and 32 pounders.

Q. 258. What are the sizes of ropes used in making grummets ?

A.

For 3 Pounders	1 inch rope.
6 „	
9 „	
12 „	1½ „ „
18 „	

Q. 259. How are they made?

A. A piece of rope of the required size and about 6 inches longer than 3 times the circumference of the low gauge of the shot the grummet is required for, is taken and opened out into three strands, one of these strands is then twisted into a circular form by taking a turn with one end round the centre of the strand forming a loop of the proper size; the ends are then worked round in opposite directions until the grummet is complete; the surplus portion of the strand being left at one end is divided into two portions, the yarns of the under or lower portion are secured by passing the upper strands between the strands of the grummet and drawing them tight, a hole having been made with a marling-spike; the ends of the strand are then cut off, the grummet is forced on the conical wooden former, and hammered with a wooden mallet until it passes through the low gauge of the shot it is intended for.

Q. 260. How are the grummets fixed to shot?

A. By means of a strap of raw sheep skin; the skin is placed in water, and when sufficiently soft, is laid on a flat table, and cut into pieces of a shape adapted for the purpose, being marked out by a former of the proper size, one of these pieces of skin is placed on a shot or shell, (if the latter, care must be taken that the fuze hole is in the centre of the skin) the shot or shell with the strap, is then turned over and laid on a grummet to keep it steady, the grummet to be attached to the shot is placed on it, the ends of the skin are passed round the grummet from the inside, drawn as tight as possible, and each pair tied together. When dry, the skin over the fuze hole is cut out with a small knife.

Q. 261. Is there any precaution taken to preserve the skin?

A. Yes, each strip or piece of skin for a shot is dipped in a solution of corrosive sublimate in the proportion of one ounce to one gallon of water.

Q. 262. What implements are required in making collars for shells?

A. Beak Iron, (fig. 85.)
Gauges, (fig. 76.)
Ladle, (fig. 91.)
Mallet, (fig. 101.)
Pan, (fig. 115.)
Plyers, (fig. 122.)
Shears, (fig. 146.)
Soldering Iron, (fig. 87.)

Q. 263. What implements are required in making grummets and grummetting shot?

A. Former for Grummets, (fig. 63.)
Former for Skin, (fig. 64.)
Gauges, (fig. 76.)
Knife, (fig. 88.)
Mallet, (fig. 101.)
Marling-spike, (fig. 102.)
Scissors, (fig. 141.)

WADS.

Grummet.

Q. 264. What is a grummet wad?

A. It is a grummet made equal in diameter to high gauges, with 2 strands of ratline attached.

Q. 265. How is it made?

A. A piece of rope of the proper size and 6 inches longer than 3 times the circumference of the low gauge of the shot for which it is intended, is taken and opened into 3 strands, one of which is made into a grummet, exactly in the same manner as laid down in answer No. 258: 2 strands of ratline cut sufficiently long to project about a ½ of an inch over the grummet, are tied together crosswise and then made secure to the grummet by a little fine twisted spun yarn.

Q. 266. What is their use?

A. They are used with breaching guns when firing cold shot, for the purpose of keeping the shot close on the cartridge.

Q. 267. What sizes of rope are required to make grummet wads?

A. For 12 Pounders.......... 1½ Inch Rope.
„ 18 and 24 Pdrs......... 2 „ „

Q. 268. What articles are required in making them?

A. Former for Grummets, (fig. 63.)
Gauges, (fig. 76.)
Knife, (fig. 88.)
Mallet, (fig. 101.)
Marling-spike, (fig. 102.)
Scissors, (fig. 141.)

Junk.

Q. 269. What is a Junk wad?

A. It is a ball made from the loose strands of Europe old rope.

Q. 270. How is it made?

A. It is made by taking a handful of old junk and rolling it into a ball; round this, strands of old rope are bound tightly in all directions, when it is nearly up to the high gauge, strands are added and their ends passed under and over those previously put on, and secured; this process is continued until the wad is a little beyond the high gauge.

Q. 271. When are they used?

A. In proving ordnance carriages, guns and howitzers, and new and rebouched guns and howitzers, also when firing hot shot.

Q. 272. What articles are required in making them?

A. Hand Hatchet, (fig. 177.)
Gauges, (fig. 76.)
Knife, (fig. 88.)
Marling-spike, (fig. 102.)

SINNETT FOR SPUNGE-HEADS.

Q. 273. What is Sinnett?

A. It is made from junk for the purpose of wigging spunge heads.

Q. 274. How is it made?

A. By platting together 5 or 6 long strands of junk; as each platt is taken, 2 short pieces of junk are placed cross-wise between the long strands, and so on,—the cross pieces vary in length, according to the size of the spunge for which the sinnett is intended.

Q. 275. What is the length of the crossing strands for sinnett?

A. For the	42	Pdr.	5½	Inches.
	32	„	5⅛	„
	24	„	4¾	„
	18	„	4¼	„
	12	„	4	„
	9	„	3⅝	„
	6	„	2⅞	„
	3	„	2½	„

Q. 276. What articles are required in making it?

A. Knife, (fig.88).—Handhatchet, (fig.177). A piece of skidding.

SINNETTING SPUNGE-HEADS.

Q. 277. How are the heads of light and heavy field spunges sinnetted?

A. They are first covered with doubled Europe canvas which is made secure by being stitched on with country twine, the sinnett is then stitched to the canvas, commencing at the top of the head, and when once round, the lower ends of the cross strands are turned over on the upper ones, and the second turn of the sinnett is secured close to the platting of the former turn, the same course is pursued until the spunge head is covered.

Q. 278. How are light and heavy field spunges finished?

A. Each strand of sinnett is untwisted and well opened, it is then clipped with a pair of scissors, and care taken that it is not cut uneven, the spunge should pass rather tight into the gun, it is then combed with an iron comb, that all twists in the sinnet be taken out.

Q. 279. What implements are required in sinnetting spunge heads?

A. Knife, (fig. 88.) Palm hand, (fig. 113.) Needle sail, (fig. 111.)

PART II.

PERPENDICULAR. (fig. 118.)

Q. 280. What is a perpendicular?

A. A common spirit level, the brass frame in which it is placed being the most convenient shape for applying it to the purpose required, the points are tipped with steel that they may not wear out.

Q. 281. What is the use of a perpendicular?

A. To take the centres of a piece of ordnance, through which centres a line is drawn on the upper surface of the piece, corresponding with its axis.

Q. 282. What is the use of this line when taken, and what is it called?

A. It is called the line of metal, and serves to lay the piece at the object against which the fire is directed, the carriage or bed being traversed to the right or left, till the line of metal and object to be struck, exactly come in line.

Q. 283. How many centres is it usual to take?

A. Two with iron guns not having disparts and tangent scales, two with iron, and three with brass mortars.

Q. 284. Why are more centres taken with mortars than guns?

A. With a gun the eye is lowered so as to look along the whole length of the piece, one centre close to the eye on the base ring, and another at the swell of the muzzle, have been found sufficient to direct the eye to the object aimed at; chalking a line along the whole surface of a gun would be a tedious operation, and occupy more time and attention, than could be generally spared on service, where indeed with light guns, centres are seldom or ever taken, as new ones would be required every time the carriage moved.

Mortars are stationary, and the eye does not, in laying them, come in contact with the piece, but is removed at some distance from it; the more centres that are taken, or the longer the line marked on the surface of the piece to be covered by the plummet line, held by the person laying the piece, the more chance there obviously must be of the direction being correctly given.

QUADRANT.

Q. 285. What is a quadrant?

A. A graduated quarter of a circle fixed to a brass bar or rod, which goes into the bore of a piece.

Q. 286. What is the use of a quadrant in gunnery?

A. To elevate or depress a piece of ordnance.

Q. 287. How many kinds are there?

A. Two—spirit level (fig. 130) and plummet (fig. 129).

Q. 288. How is a quadrant applied to a piece of ordnance?

A. The long shank is placed in the bore on the lower surface as near as possible in the centre and kept steady with the hand, it should not however touch the shot or shell in the piece. In using the instruments the arc of the spirit quadrant will be upwards, and that of the plummet quadrant downwards.

Q. 289. How is the angle of elevation taken with the spirit level quadrant?

A. The index to which the level is attached, is fixed to the required angle on the graduated arc, previous to the shank being put into the bore of the piece. The piece is then elevated or depressed, till the whole of the bubble in the glass level can be seen and is steady.

The level is then parallel to the horizon or spot on which the piece is standing, the axis of the piece will form with these parallel lines the angle at which the index is set.

Q. 290. How is the angle of elevation taken with the plummet quadrant?

A. A musket ball or weight attached to a thread is suspended to a small hook or screw head, projecting from the centre of the graduated arc, from which by the properties of gravity it will hang perpendicularly downwards, the piece is then gradually elevated or depressed, till the thread covers the required angle on the graduated arc. The piece will then form the angle denoted by the plummet line on the graduated arc with the spot on which it is standing, or with the horizon.

TANGENT SCALE. (Fig. 139.)

Q. 291. What is a tangent scale?

A. A brass rod sliding in a groove which is cut for it behind the base ring of field pieces; on the face of this rod tables are engraved by which the length of fuze, angle of elevation, and range can be ascertained instantaneously.

Q. 292. What is the use of a tangent scale?

A. To elevate pieces of ordnance.

Q. 293. How is a tangent scale made?

A. ·017455 of an inch is the tangent of one degree to every inch of a gun's length, from the hind part of base ring to the swell of the muzzle, therefore, if the distance in inches between these two points be multiplied by ·017455, the product will be the tangent of one degree.

Q. 294. How is the tangent scale applied to use?

A. The distance of the object from the piece being known, loosen the adjusting screw, and raise the rod until the required distance engraved on it appears, then fasten the screw, get the top of the scale, the sight or centre on the swell of the muzzle, and the object to be fired at in a line, the piece will then be elevated at the angle corresponding with the distance and the object itself.

Q. 295. What are the different figures and letters on the tangent scale for?

A. On the flat side the figures denote the angle of elevation for round shot, and spherical case. On the round side the first fraction shows the length of fuze composition in parts of an inch, the second fraction $\frac{\text{From}}{\text{To}}$ the numerator tells at what distance the spherical case will burst with that length of fuze, and the denominator the distance the small balls will fly afterwards. For instance 4° $\frac{7}{10}$ $\frac{1160}{1330}$ indicates that with 4° elevation and $\frac{7}{10}$ of an inch of fuze composition the spherical case will fly 1160 yards before bursting, and the small balls liberated from the shot will continue their flight to 1330 yards.

Q. 296. Why does the scale commence at 2° ?

A. Because the dispart of a piece of ordnance is near 1° consequently the elevation cannot be taken under that; if the dispart be placed on the muzzle, the scale would commence with 1°.

CALIBRE COMPASSES. (Fig. 33.)

Q. 297. What are calibre compasses ?

A. The common pocket calibre compasses consist of two flat brass plates six inches long connected by a screw, and about 1½ inch in breadth, with a variety of tables engraved on them, those required for using the instrument are marked "inches" "guns" "shot"; the degrees are round the semicircular end. The points are tipped with steel that they may not wear out.

Q. 298. To what use are they applied ?

A. To measure the calibre of any piece of ordnance in order to ascertain its nature; likewise the diameter of shot and shells for the same purpose; angles may also be taken and laid down with it.

The calibre compass is the most useful instrument an Artillery officer can have, as the most experienced eye cannot judge accurately of the nature of pieces of ordnance and shot without measurement.

Q. 299. How is the calibre of a gun taken ?

A. The instrument is placed in the bore of the piece with the legs crossing each other, the two steel points touch the sides of the bore, the instrument is then turned gently round to ascertain the exact diameter of the bore, it is then withdrawn and the plate with "guns" and "inches" on it inspected; the figure cut by the leg crossing it on "guns," will denote the calibre of the piece, relative to its shot. For instance, figure 9 will denote a 9 pdr. the division on the column of inches, the diameter of the bore in inches, which in this case will be 4·2 inches; each division in the column between "guns" and "inches" is ⅒ of an inch; a straight line connecting the two steel points will be exactly 4·2 inches.

Q. 300. How is the calibre of a shot or shell taken ?

A. Open out the legs and place the ball between the two steel points, the inside edges of the legs of the compasses are hollowed, so that the points only may touch the surface of the shot; move the instrument up and down with your hand, to ascertain that you have taken the proper diameter, that is of the largest part, inspect that part of the circular end marked "shot" on the upper plate, see which division the arrow above it cuts, the figures will show the nature of the shot in lbs. thus the arrow cutting 18 of the index will show that the shot is an 18 pdr. and so on (the figures in the lower row are intended for the divisions in the upper one), to ascertain its diameter, examine the lower plate marked "inches" and observe where the bevelled edge of the plate marked "shot" cuts, which in this case will be 5 inches.

Q. 301. How do you take the angle of elevation with the calibre compasses?

A. Place a straight stick *about* 18 *inches in length* in the bore, on the lower surface as near the centre as possible, allowing the end to project beyond it about 10 inches, to which fasten a plummet line, place the circular part of the compasses as near the junction of the stick and line as possible without moving either, let the outer part of one leg in its whole length touch the under part of the stick, move the other leg till it in the same manner comes in contact with the plummet line—remove the instrument and observe what degree the bevelled edge cuts on the semicircle below, which will be equal to the complement of 90° of the true angle of elevation.

This method is not so correct or so easily effected, as with the quadrant or tangent scale.

COMPASSES

For taking the thickness of a Shell's bottom. (Fig. 34.)

Q. 302. How do you take the thickness of a shell's bottom with this instrument?

A. Put the straight leg in the fuze hole of the shell, and let it press against the bottom of the shell, then shut up the compasses as far as you can, that is, till the check on the curved part near the handle stops it; by inspecting the instrument, it will be evident, the straight leg and the point of the sliding scale at the end of the curved leg, will be in a line; press down the scale till it touches the shell's bottom, which alone will prevent the two points meeting, the figure on the scale cut by the arrow will give the thickness of the bottom in tenths of an inch: for instance, if 8 be cut, the shell will be $\frac{8}{10}$ of an inch thick at that part.

The legs of this instrument are tipped with steel to prevent their wearing out.

COMPASSES

For taking the thickness of a Shell's side. (Fig. 35.)

Q. 303. How is the thickness of the side of a shell taken with this instrument?

A. Put the straight leg with the end bent inwards into the fuze hole, and make it touch the side of the shell in any part, shut the compasses till its fellow circular leg touches the outer surface of the shell, when it will be evident the side of the shell will be between the two points; to ascertain its thickness, look at the scale above of tenths of an inch, and observe the figure cut by the index which will indicate the thickness of the shell in tenths of an inch: for instance, if the index cuts the figure 8, the side of the shell will be $\frac{8}{10}$ of an inch thick.

The legs of the instrument are tipped with steel to prevent their wearing out.

FUZE AUGERS. (Figs. 2 and 3.)

Q. 304. What is the use of a fuze auger?

A. To bore the composition out of fuzes, when the required length is so short, that if cut across there would not be sufficient wood to hold in the fuze hole as is generally the case with spherical case fuzes.

Q. 305. How is the brace auger used?

A. The end of the bit is placed against some level surface, the brace being held in the left hand with its bend upwards, the end of the slide with scale attached is secured even with the point of the bit: the index or lower slide is placed so that its bevelled edge shall cut the mark of ten tenths, it is then made fast; the upper slide is then set at the number of tenths required, for instance, if 4 tenths of composition is required, it is moved until the figure 4 is even with the bevelled edge of the index and secured. This instrument should always be set with reference to the length of composition *required to be left in the fuze.*

The head of the fuze is placed against the side of the carriage or any thing that will keep it steady and the composition bored out.

Q. 306. What is the difference between a brace and hand auger, and which is the most useful?

A. The hand auger has merely the wooden handle screwed on the brass scale and is used like a gimblet. The brace auger is the most convenient of the two, the handle rests against the body and the operation is performed with certainty and expedition; the hand auger is apt to hurt the hand, and the auger to slip, not being supported as with the brace; more time is required in boring a fuze with a hand auger.

DRIVER AND SETTER. (Fig. 49.)

Q.. 307. What is a setter and its use?

A. A setter is a cylindrical piece of wood hollowed about ½ an inch in depth, to receive the head of a fuze, the diameter must depend on the size of the fuze for which it is required; the height about 3 inches, and the handle which is a continuation of the same cylinder, smaller and high enough to allow the hand to grasp it; on the top of this handle the driver is applied in setting the fuze.

Q. 308. What is a driver and its use?

A. A cylindrical piece of wood differing from a common mallet only, in the handle and striking part being all one piece of wood, the handle sufficiently long and of the most convenient size for being held in the hand.

Q. 309. How is a fuze set?

A. A little oakum is put up the hollow part of the setter, or the head of the fuze would be injured by coming in contact with the hard wood of the setter. The fuze being placed by the hand as far into the fuze hole as can be done, the hollow part of the setter is placed on it, and the left hand on the handle, and several smart blows given it with the driver. After every blow the handle of the setter should be moved round without being lifted up, so that no two blows should fall on the same spot—this precaution is necessary to secure the fuze from injury.

FUZE ENGINE. (Fig. 50.)

Q. 310. What is the use of a fuze engine?

A. To extract a fuze from a shell more particularly applicable to large shells.

Q. 311. How is it used?

A. The circular part at the bottom rests on the shell with the head of the fuze in its centre. The two small notches in the under part are to receive the lugs on the shell which keep the instrument steady.

The lower screw is turned till the vice embraces as much of the head of the fuze as projects above the shell, it is then fixed tight on it, the upper screw being turned will draw up the vice, and the fuze with it.

BRASS FUZE PINCERS. (Fig. 121.)

Q. 312. For what purpose are brass fuze pincers required?

A. They are used to draw the fuze out of a shell when it is damaged in any way, it will only answer for small and short fuzes, such as those for spherical case shot. The pincers are opened and the hollow part put round the head of the fuze, they are then closed, firmly grasped, and turned round with the hand until the fuze is extracted. Fuze pincers have generally two circular holes, to answer for different sized fuzes, and are notched round the inside to take a better hold of the head of the fuze.

SPIKES.

Q. 313. How many different kinds of spikes are in common use to render a gun temporarily unserviceable?

A. Two; the jagged (fig. 156), and spring spikes (fig. 157).

Q. 314. What is a jagged spike, and how is it used?

A. A jagged spike is nearly square, all its angles are cut like a file, but coarser and deeper, the points are jags being upwards.

Q. 315. To clear a vent of this spike what method is adopted?

A. Load with rather more than a third of the shot's weight of powder, soak two wads in a solution of saltpetre, and when dry, place a shot between the wads, which must not be made too high;

bind them together with long strands of quick match, and ram the whole home on the charge, put an ounce or two of gunpowder in the copper ladle, and scatter it along the whole length of the bore, then fix a wad or turf in the muzzle of the piece with half a portfire passed through it, by which means the gun may be easily fired. If this does not cause the spike to remove, repeat the experiment with an additional shot or wad, and charge equal to half the shot's weight.

With brass guns it would be advisable, a day or two previous to the experiment, to scratch close round the spike with a graver, and put a few drops of Nitric acid in the circle, which in a few hours will find its way down between the spike and the metal, particularly if the former does not completely fill the vent.

Q. 316. What is a spring spike and how is it applied?

A. The head is like that of a musket ramrod, the lower part has a spring on one side opening upwards. The point is driven into the vent which presses the spring close to the body of the spike; when the spring has passed through the metal into the bore, it opens out, the instrument cannot be drawn from the outside until the spring is broken off or closed.

Q. 317. Are there no means for extracting a spring spike?

A. Yes, in the following manner; on one side of the head of the spike there is a small notch cut; this coincides with that side of the spike on which the spring is attached. To extract the spike, this notch is placed towards the muzzle, and the spike drawn up as far as it can be by hand; the rammer head is then put into the bore and the spring pressed close to the body of the spike, the latter can then be drawn out of the vent.

Spring spikes are only used when it is expected the guns will be immediately re-taken, as the spike can be so easily withdrawn.

SEARCHER. (Fig. 144.)

Q. 318. What is the use of a searcher?

A. To examine the bore of a gun with a view of ascertaining the distance from the muzzle of any cavities that may be in it.

Q. 319. How is the bore of a gun examined with a searcher?

A. The reliever (fig. 144) is pushed on to the bend of the points, so as to prevent their spreading, which enables the instrument being introduced into the piece, and when the points touch the breach the reliever is drawn back a little to liberate the points, the handle is then turned round and moved backwards and forwards in all directions from the breach to the muzzle, so that in case there should be any cavity, one of the points may run into it, when this takes place, the handle is marked with chalk close to the muzzle which will show the distance of that part from the cavity; the reliever is then pushed forward which will relieve the points by pressing them towards the centre, and consequently out of the hole; the surface of the piece is also to be chalked as near as you can judge at the cavity; the single pointed searcher or fish (fig. 145) is then introduced, having some wax on the point, the chalk marks will be a pretty good guide to the cavity up which it is forced, the wax will take its shape, which can be measured when withdrawn.

Q. 320. How is the bottom of the vent examined?

A. Take a piece of twine three times the length of the gun, make a loop at one end and pass it down the vent, introduce the searcher into the bore, withdraw the reliever and turn the searcher round in the bore until one of its points enters the loop or becomes entangled with the twine, draw out the twine at the muzzle, and at rather more than the distance from the muzzle to the vent, fasten a small piece of wood about half an inch square and one-tenth of an inch in thickness, upon this mould a piece of pure bees'-wax of a conical shape, so as to enter the bottom of the vent about half an inch, the bees'-wax must be oiled to retain the impression of the vent after it is withdrawn; the twine is now drawn up from the outside of the piece at the vent, until the wax touches the bottom of the vent, which after being carefully plumbed, so as to bring the apex of the waxed cone in the direction of the vent, must be drawn steadily up for about half an inch; the wax is then withdrawn from the muzzle, and the impression made on the wax, will show the state of the bottom and lower part of the vent.

OAKES' BOUCHE, VENT, AND BORE-EXAMINER.

Q. 321. Is there any instrument in use for examining the bouche, vent, and bore of a piece of ordnance?

A. Yes, the bouche mirror, by means of which the bottom of the bouche and the whole length of the vent, as well as the upper surface of the bore can be examined, and the slightest flaw detected.

Q. 322. Describe this instrument and the method of using it?

A. It consists of a small circular mirror, something less than the diameter of the bore of the piece, attached to the end of a staff by a hinge, for the purpose of giving it the angle required, the mirror is introduced into the piece and placed at such an angle under the bouche as will give the fairest view of it, when the rays of light are reflected upon it from another mirror placed in front of the muzzle.

PART III.

The following is the method observed at the Artillery Depôt of Instruction in making Percussion Caps.

1. The names of the different machines are :—The circular cutting machine, flatting or roller machine, cross cutting press, annealing furnace, pickling cistern, striking up press, boiler, small rumbler, loading machine, pressing machine, damping machine, steam bath, glazing lathes, large rumbler.

2. The copper used for making percussion caps is received in sheets 4 feet long by 2 feet wide, averaging about 8 lbs. in weight; and ·016 of an inch in thickness.

3. The sheet being divided into two, cross-wise, and the edges flattened with a wooden mallet, is put in pickle for 12 hours, then taken out, well washed with clean water, and rubbed thoroughly dry, with saw dust. The half sheets are then ready for cutting into strips.

4. *Circular Cutting Machine.*—The half sheets after being carefully weighed, are placed, one at a time, on the board of the circular cutting machine, and divided into strips of about 2½ inches wide, care being taken to keep the edge of the sheet close up to the guide, that the strips may be parallel.

5. *Flatting Roller Machine.*—The strips are taken to the rolling machine, and passed between the flattening rollers, reversing the strip each time of passing, until it fits the gauge.

6. *Cross Cutting Press.*—The strips are now issued to the cross cutting press, and cut into crosses, a day's work for one cooly is 70 lbs. of strips, which will yield from 43 to 44 lbs. of crosses, the remainder is called "cuttings," and is returned to the Arsenal.

7. *Annealing.*—Before the crosses can be struck into caps they require to be annealed, which is done in the following manner; about 4 or 5 lbs. of crosses are put into a pan made of sheet iron, about 8 inches long by 5 wide, which is placed in the furnace and

surrounded with burning charcoal; the crosses must be frequently stirred, when they become of a blood red heat, they are taken from the furnace, and thrown into cold water, care being taken to keep the water as cool as possible; 100 lbs. of crosses is a day's work for one man.

8. *Pickling and Washing.*--The annealed crosses are put into pickle for a whole night, they are taken out in the morning, washed with clean water to free them from the Acid, and finally put into a small rumbler with dry saw dust, the rumbler being turned until the crosses become perfectly dry and clean.

9. *Striking up Presses.*—The crosses thus prepared are carefully weighed to the coolies at the striking up presses, each cooly receives 18 lbs. weight of crosses: they are placed in a small box, and a small quantity of cocoanut oil poured over them; the box is then shaken that all the crosses may partake of the oil, they are afterwards struck into caps by the coolies at the striking up presses; 18 lbs. of crosses will yield on an average 10,000 caps.

10. *Boiling.*—In order to free the caps from the oil, they are boiled in a solution of 1 lb. of pearl ash to 5 gallons of water, 50 lbs. of caps are put into a copper drainer, and when the liquor in the boiler becomes warm, the drainer containing the caps is placed in it, the caps must be frequently stirred with a copper hook or ladle, and the oil which rises to the top skimmed off; after boiling about 15 or 20 minutes, a few are taken out with the ladle, washed with clean water, put into pickle for a few minutes, and again washed with water, should they be perfectly clean the whole are taken out of the boiler and treated in like manner; in washing them, care should be taken to rub them well through the hands; when the caps are perfectly free from the acid, they are put into a small rumbler with dry saw dust, the rumbler being turned till the caps are dry and clean, the saw dust should be changed 3 or 4 times during this process; the caps are now placed in the large rumbler with clean dry saw dust, and turned till partially polished, then taken out and sifted to separate the saw dust from them; they are then ready for filling.

11. *Filling Plates.*—The brass plates (each contain one thousand holes) are filled by throwing two or three thousand caps

over it, and by rolling them backwards and forwards, the remaining holes are filled by hand and the surplus caps taken off, and any faulty ones rejected.

12. *Loading Machine.*—The plate so filled is then fixed in the loading machine and about 1 oz. of composition is spread on the upper plate with a paper spreader, which must be used very gently to prevent friction ; when every hole is full, the surplus composition is taken off, and the upper plate moved forward by means of the lever, so as to bring the composition contained in the holes of the upper plate, over those of the lower one, and directly over the caps ; two or three taps given with a small mallet on the frame of the machine, will cause the composition to fall into the caps.

13. *Pressing Machine.*—The plate containing the loaded caps is removed to the pressing machine, and the composition contained in the caps, pressed row by row in succession.

14. *Damping Machine.*—The plate is placed on the moveable board of the damping machine, and varnish poured into the tin tray, that part of the machine containing a row of 25 steel pins, is gently dipped into it, and thus drops of varnish are successively deposited in each row of caps as it is brought under the steel pins by the motion of the machine, the pins must be frequently wiped, or the varnish will not drop regularly into the caps.

15. *Steam Bath.*—The plate is placed for 2 or 3 minutes in the copper steam bath, for the purpose of evaporating the spirits of wine and thoroughly drying the shell-lac contained in the varnish.

16. *Glazing.*—The caps are now glazed, one at a time by means of glazing lathes fitted up for the purpose, each cooly glazes 10,000 daily ; this process is for the purpose of polishing or glazing the shell-lac deposited over the composition, and thus affording a protection to it from the effects of the atmosphere.

17. *Polishing.*—About 50,000 caps are put into the large rumbler with clean dry saw dust, and the rumbler turned regularly for three or four hours, the saw dust being changed every hour ; when the caps are perfectly polished, they are taken out of the rumbler and sifted, weighed and put into boxes ready to be sent to the Arsenal, and from thence they are issued for service.

18. *Composition.*—The composition used for filling caps consists of the following ingredients and proportions.

	oz.	drs.
Fulminate of Mercury, - - - -	4	0
Chlorate of Potass, - - - - -	9	0
Green Glass pounded and sifted, -	2	0
Total oz.	15	0

The above ingredients form one mixing, and will prime about 17,000 caps.

19. *Mixing Composition.*—The two last named ingredients under the head of composition, must be separately passed through a brass wire sieve of 60 meshes to the lineal inch, having a leather top and receiver, carefully weighed and put into a common wash-hand basin, and intimately mixed with a soft sash or painter's brush ; the fulminate is then added in small quantities at a time, and thoroughly incorporated with the other two ingredients ; the whole mixing is then passed through the sieve and finally put into an earthen jar, having a leather top or cover, and may be considered ready for use ; the greatest care is necessary in mixing, especially after the fulminate has been added, as the least blow is liable to cause an explosion.

20. *Varnish.*—The varnish used for caps is an alcoholic solution of shell-lac, and is prepared in the following manner : one quart of spirits of wine and four ounces of finely pounded shell-lac are put into a stone jar or bottle and kept in front of a fire, or in some warm place and frequently agitated, when the solution becomes quite clear and the colour of dark brandy, it is strained off, and put in a clean bottle, which must be closely stopped ; it is then ready for use.

21. Fickle is composed of three parts of sulphuric acid " by measure" to fifty-six of water.

The Preparation of Fulminate of Mercury.

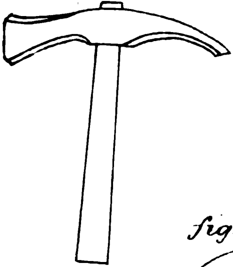
Fulminate of Mercury is prepared by dissolving one ounce weight of quicksilver, in 7½ ounces by measure of Nitric Acid of specific gravity 1·4, the bottle containing the Acid and quicksilver is placed in warm water to accelerate the dissolving of the latter, the solution is slowly poured into a large mouthed bottle, containing ten ounces by measure of spirits of wine of specific gravity ·83 (this bottle should hold fully six times the bulk of the mixed liquids) in a few seconds after the solution has been added to the spirits of wine, bubbles of gas will proceed from the bottom of the liquid, gradually increasing in number and magnitude, till a general fermentative commotion of a very active kind is generated, and the mixture assumes a frothy appearance; a white gas now issues from the mouth of the bottle, which is very combustible and must be suffered to escape freely into the air at a distance from any flame.

As soon as the effervescence and concomitant emission of gas have ceased, the contents of the bottle are washed out with distilled water, and the whole is thrown into a filter, which is fitted into a glass funnel; the fulminate is washed until the drainings no longer redden litmus paper; when the filter is free from acid it is lifted out of the funnel, the Fulminate spread on an earthenware plate, and dried by placing the plate over a pan of hot water.

The Fulminate after being dried is put up in paper parcels of a quarter of an ounce each, and these again in packets of 8 papers, or 2 ounces, this being the quantity required for each mixing of composition, these packets are then packed in a tin box, and kept in a secure place.

FINIS.

fig. 1.



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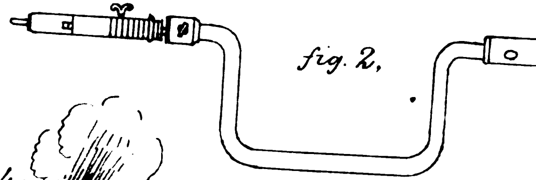

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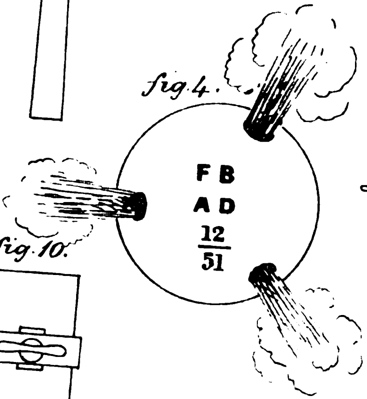

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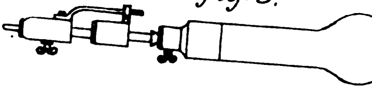

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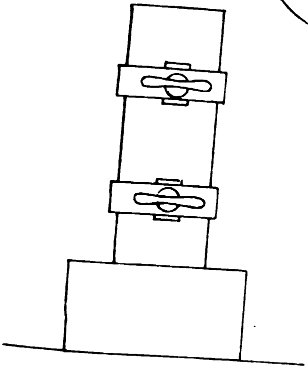

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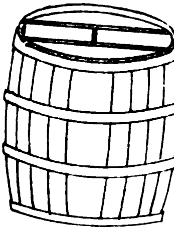

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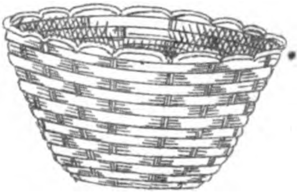

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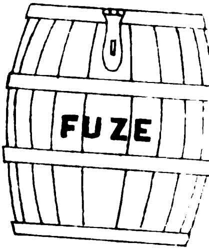

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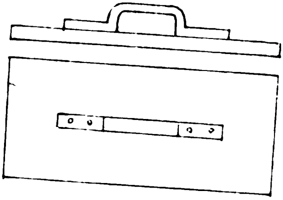

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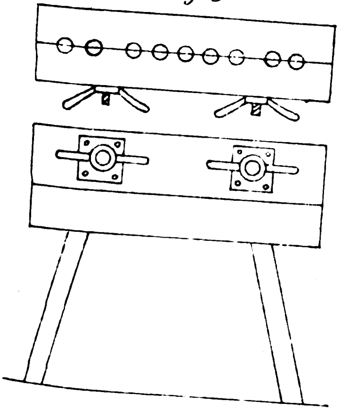

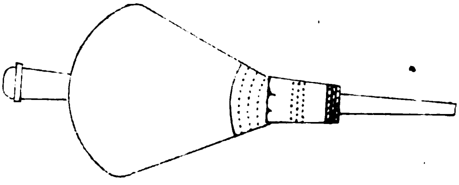

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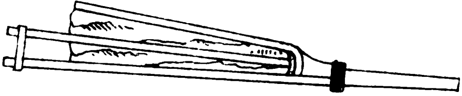

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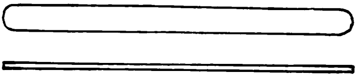

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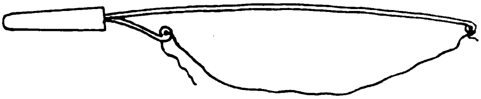

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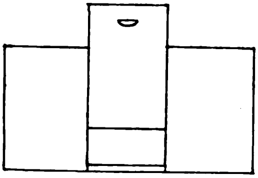

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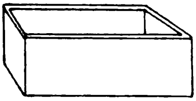

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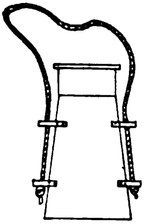

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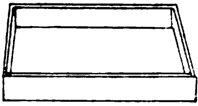

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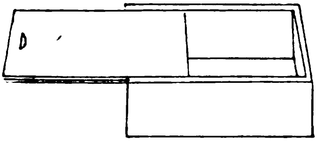
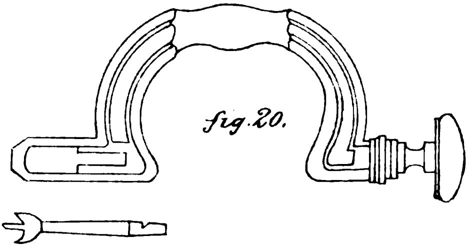
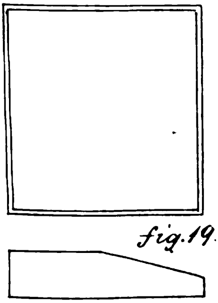


fig. 20.





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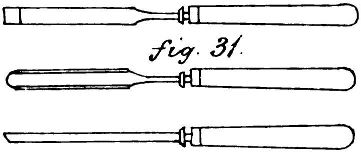

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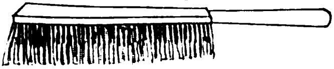

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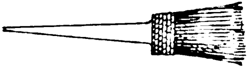

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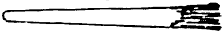

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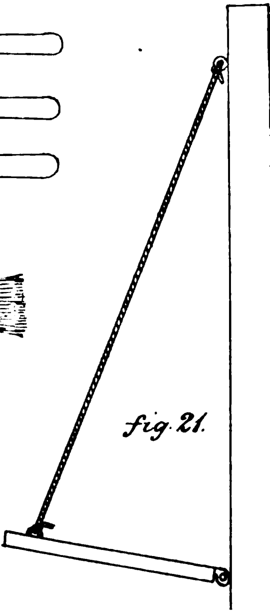

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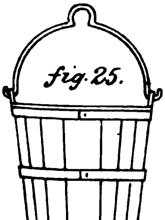

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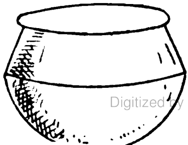

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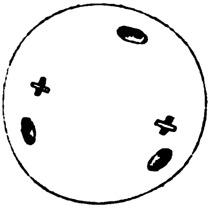

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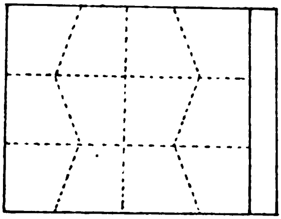

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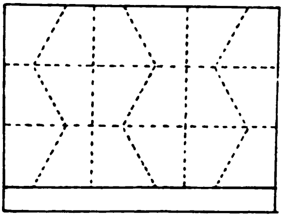

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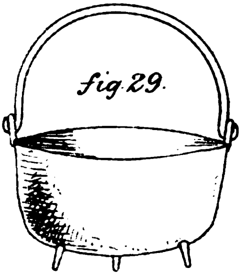

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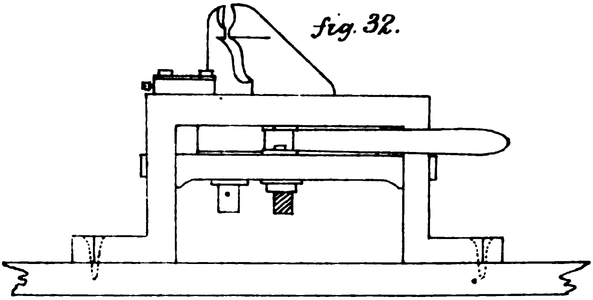

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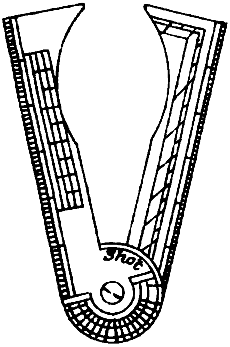

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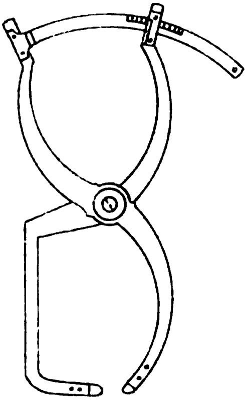

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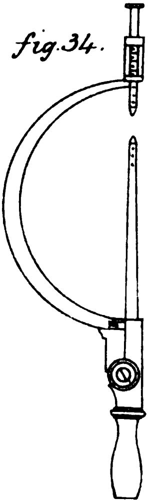

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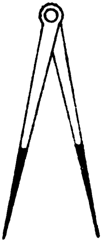

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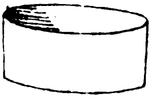

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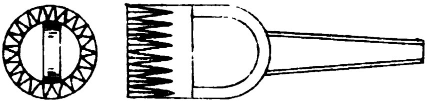

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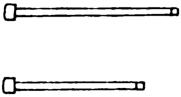

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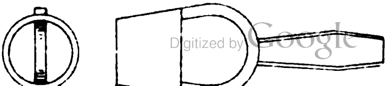

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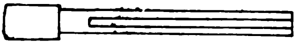

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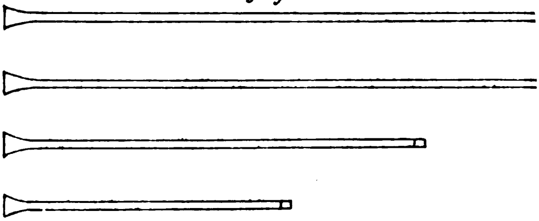

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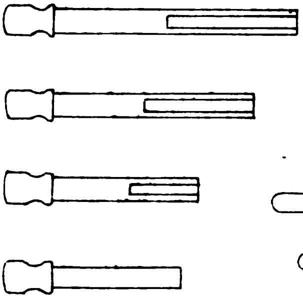

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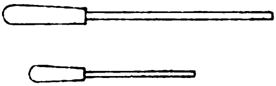

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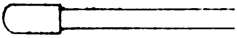

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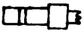

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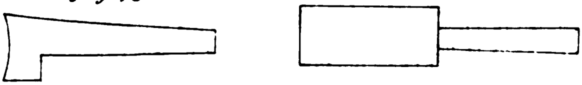

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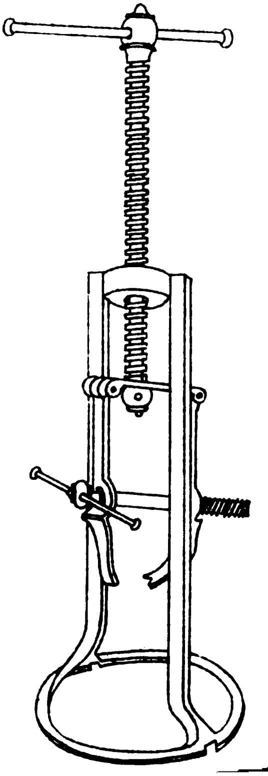

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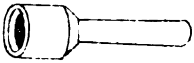

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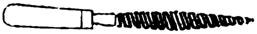

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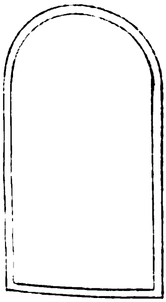

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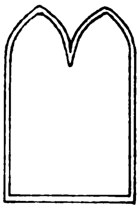

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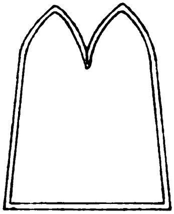

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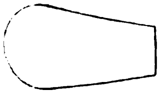

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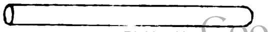

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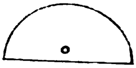

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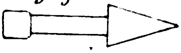

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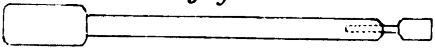

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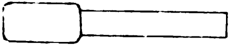

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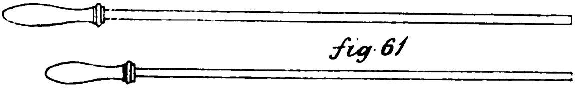

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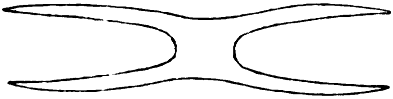

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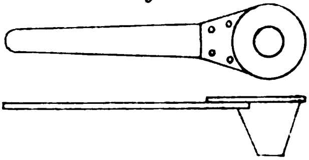

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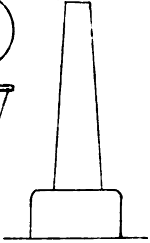

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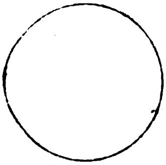

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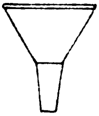

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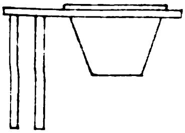

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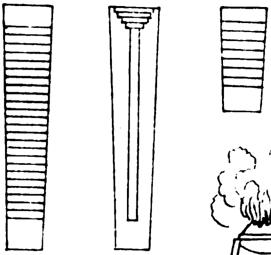

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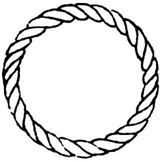

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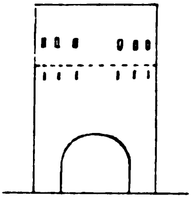

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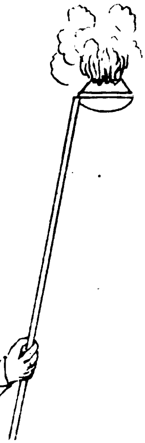

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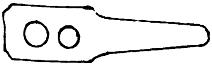

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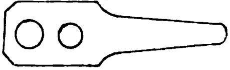

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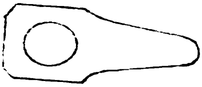

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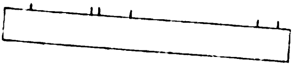

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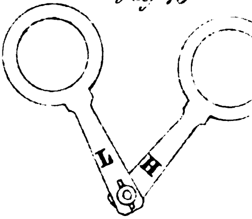

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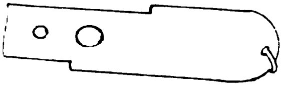

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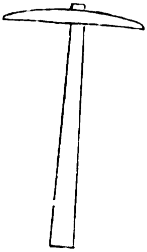

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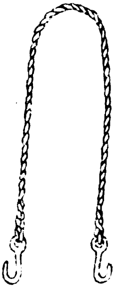

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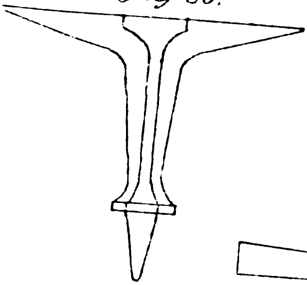

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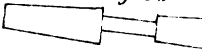

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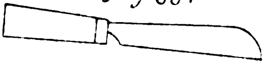

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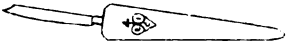

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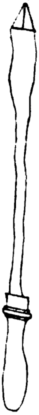

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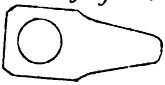

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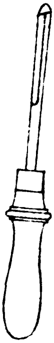

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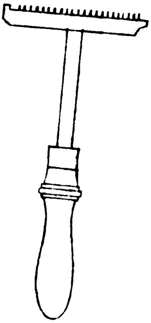

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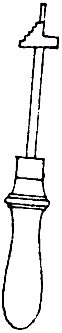

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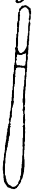

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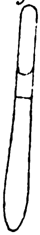

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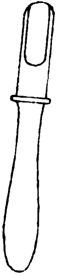

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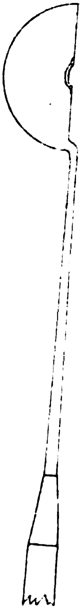

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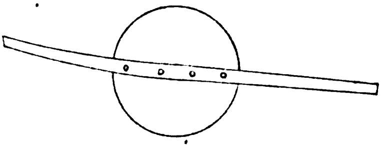

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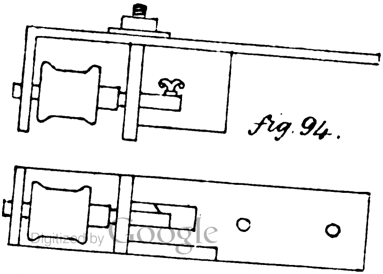

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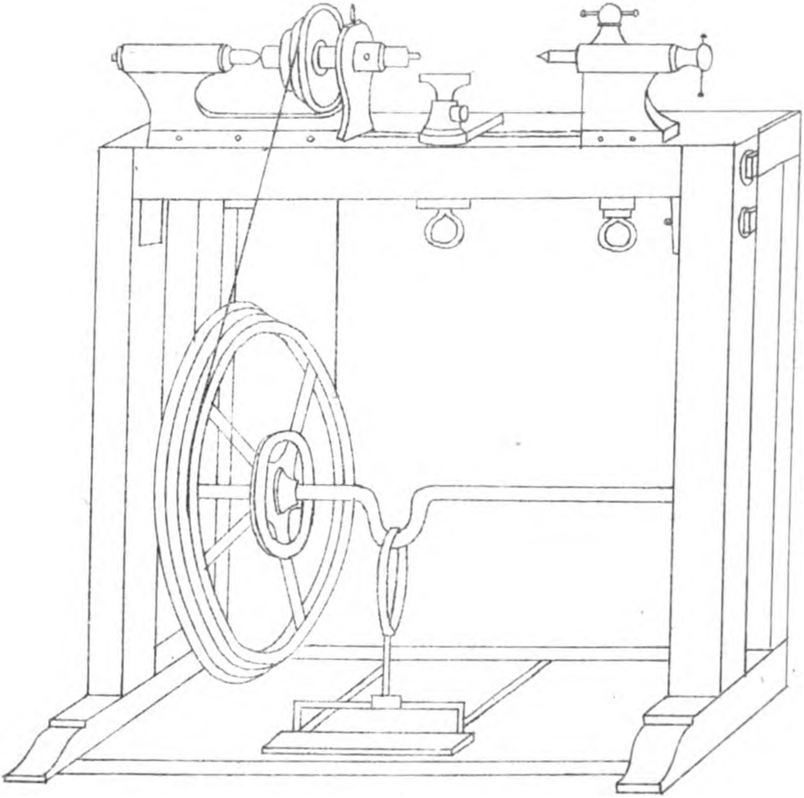

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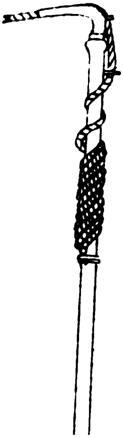

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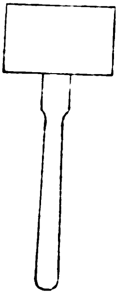

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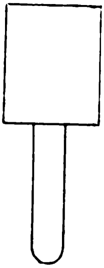
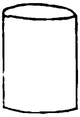


fig. 9

fig. 103.



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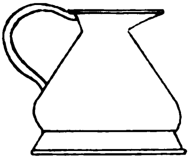

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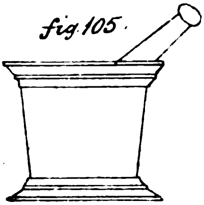

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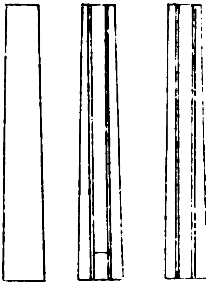

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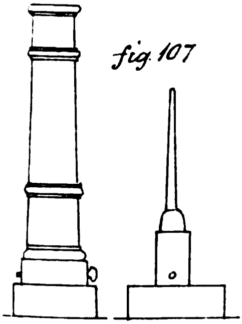

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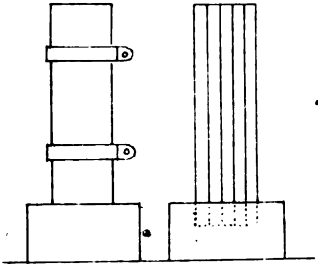

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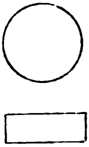

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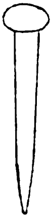

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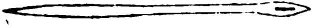

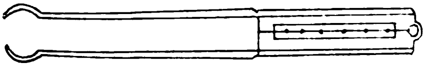

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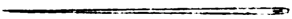

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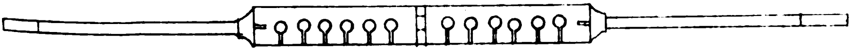

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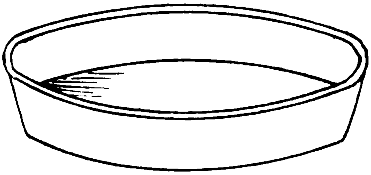

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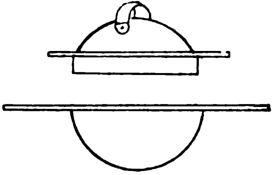

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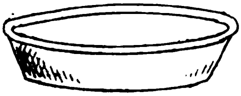

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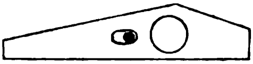

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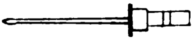

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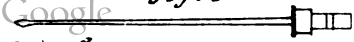
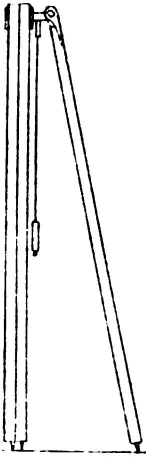


Art.y Depot Lith.d

fig 117.



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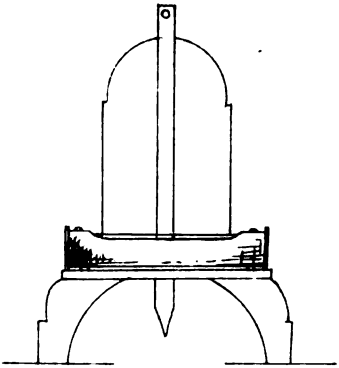


fig. 1

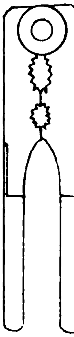
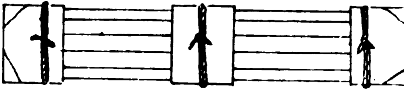


fig. 124



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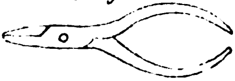
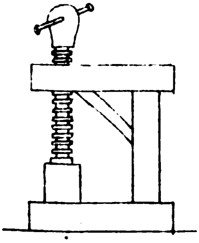


fig 123.

fig. 126



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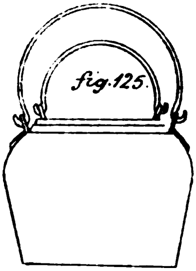

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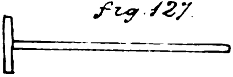

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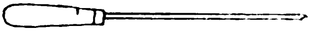

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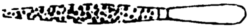

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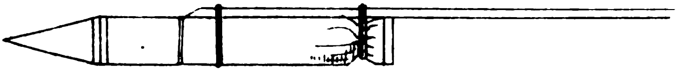
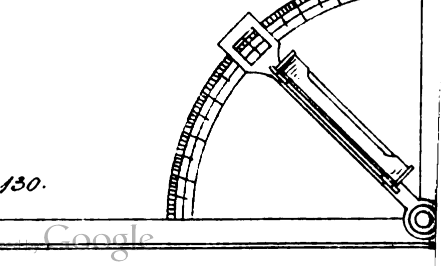


fig 133.

fig. 130.



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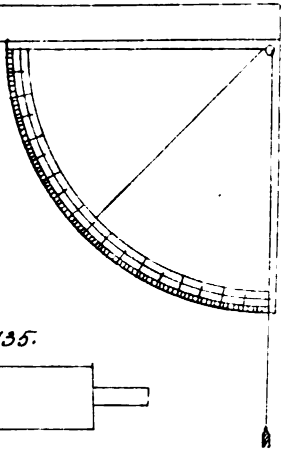

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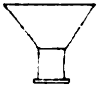

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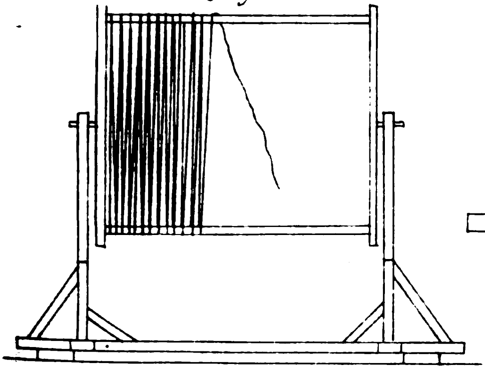

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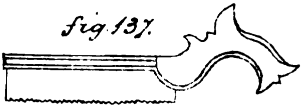
fig. 137.



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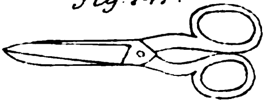

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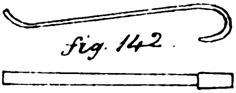

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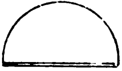

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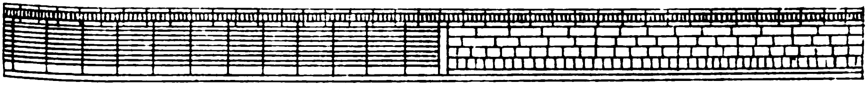

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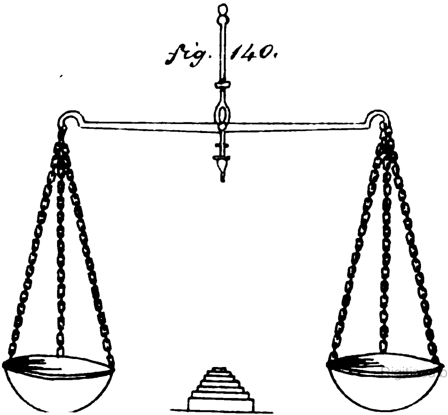

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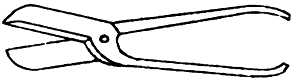

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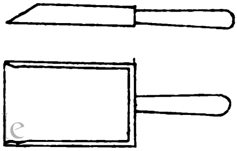

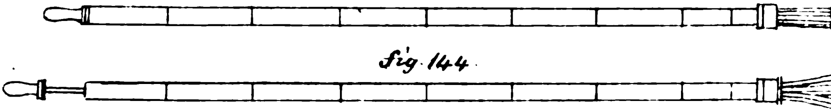

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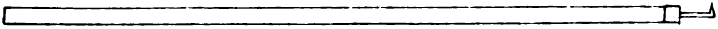

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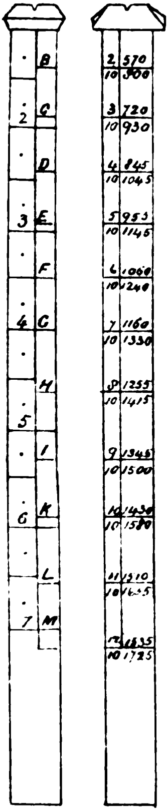
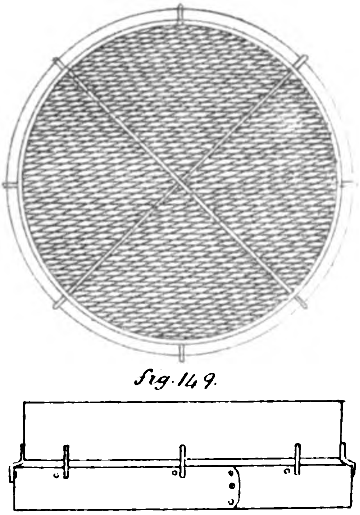
fig. 139.





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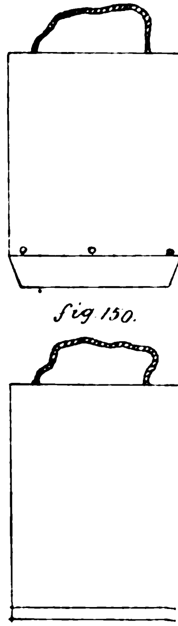
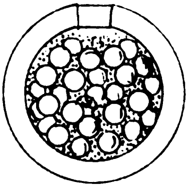
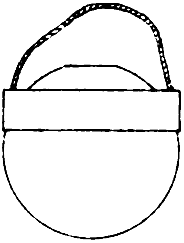


fig. 150.

fig. 152.





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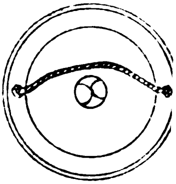

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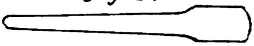


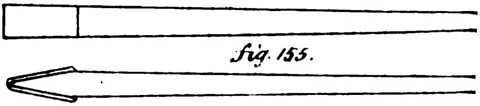
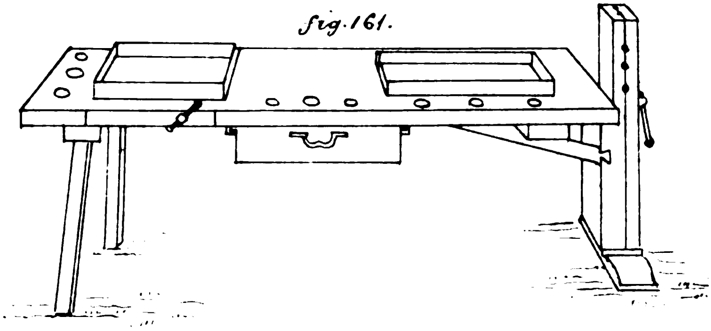


fig. 155.

Arty. Depôt. Lithd.

Fig. 161.



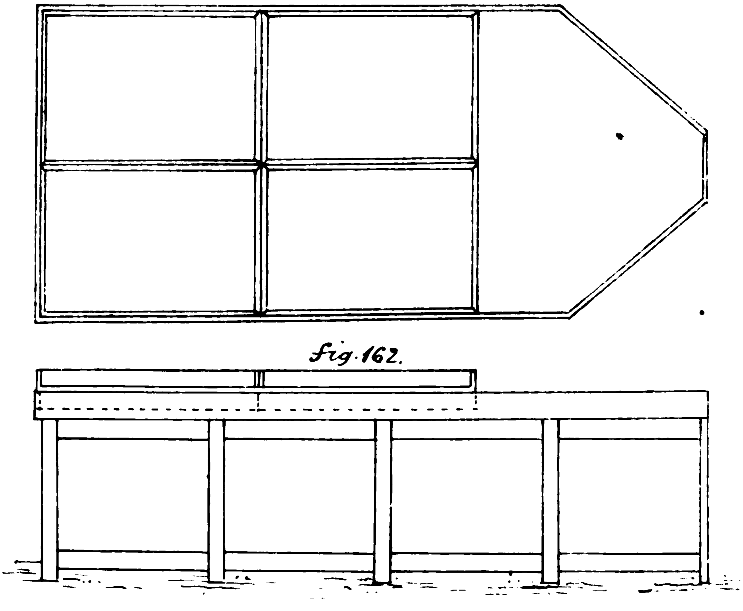
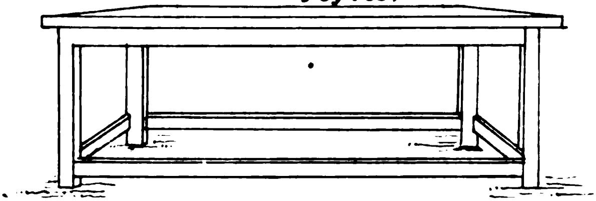


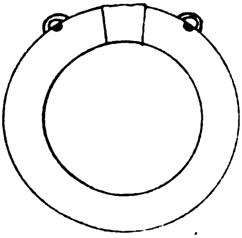
Fig. 162.

Fig. 163.



Arty Depôt Lithd

fig. 147.



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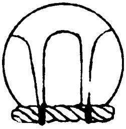

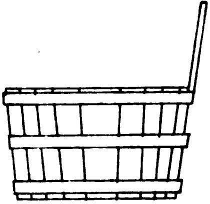

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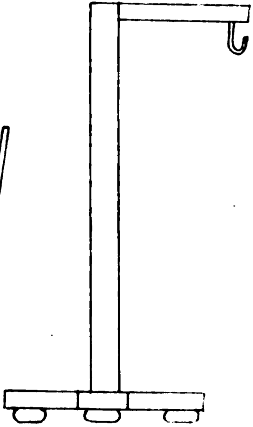

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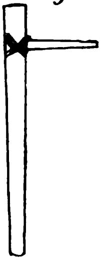

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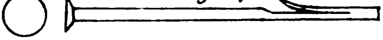
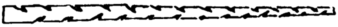


fig. 156



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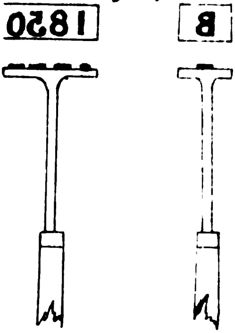


fig. 167.

fig. 166.

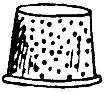
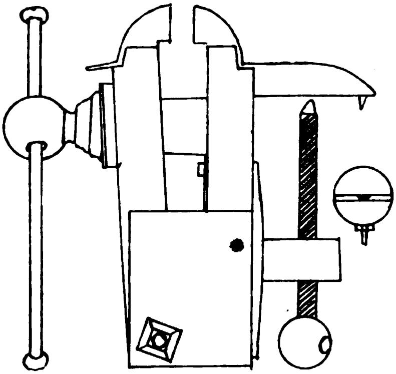


fig. 168



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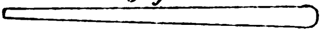
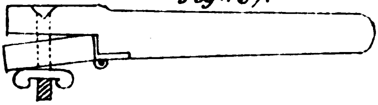


fig. 169.



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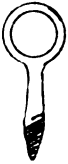

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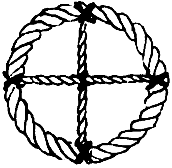

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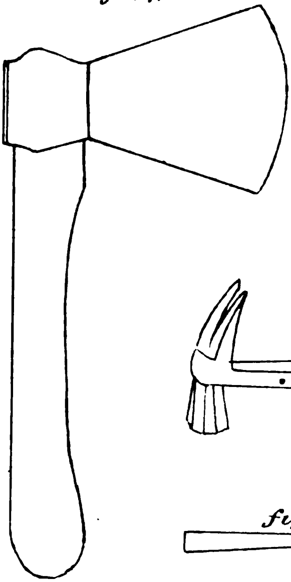
fig. 177.



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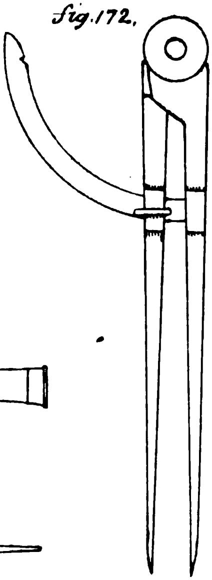

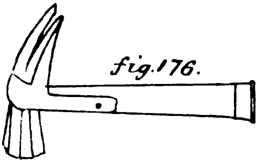

fig. 176.

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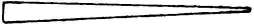

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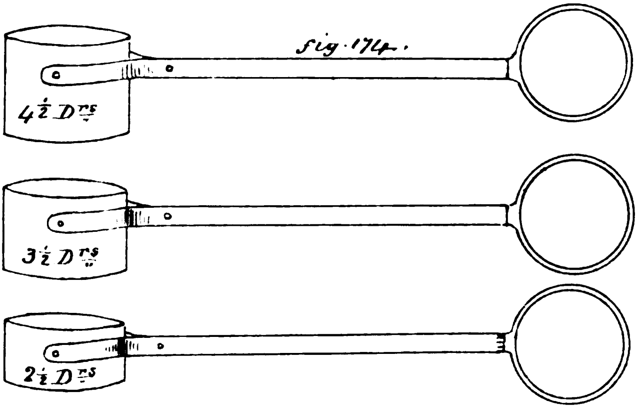
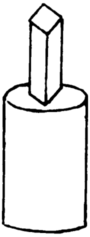


fig. 175.



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Memorandum.

Artillery Depôt
St. Thomas' Mount
15th January 1849.

Several applications having been made to the Director of the Artily. Depôt for complete sets of Artillery Records, any one, who has a complete set for sale is requested to inform the Director of it, and to mention the price required for the same.

II. – Several Officers have also applied to the Director for spare numbers of past dates, should any one have spare numbers which they do not require, the Director will be very happy to receive charge of them, either in deposit for transfer, or for sale according to the instructions sent to him.

Captain
Director.